

HOW WORLD OF WARCRAFT LOST THE HYPE:

An Agent Based Model approach through Gamers' Motivations.

Term Project Report

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ABSTRACT

World of Warcraft has lost more than 3 million active subscriptions in the last three years. The game's community has addressed this issue claiming the game is not what it used to be and that several game modifications along the years have significantly changed the playing experience. These changes not only affect the game experience but also directly affect players purpose to play it. The overall impact on players' is highly driven by their motivations to play. An agent based model is proposed to study the decision of players to stay or leave the game according to their motivations and the changes that historically occurred through expansions and patches. Implementing achievement and socialization (Yee, 2008) motivations agents replicate a similar subscription time trend with a particular composition. An attempt to forecast next expansion is made.

1 INTRODUCTION

1.1. World of Warcraft lost the hype.

World of Warcraft (WoW) is clearly recognized as one of the most successful massive multi player role playing games (MMORPGs) developed until now. Along the years it has amassed near a total of 100 million players through 9 years of existence with an impressive peak of 12 million active subscriptions in 2010 (Blizzard, 2013). Today, the game has near 7 million users after a three year significant decrease

that accounted for around 4 million active player loss. This huge drop in active players seems to be just an echo of the already well known negative comments within the community. Many modifications have been made being most of them attractive secondary features.

1.2. Game design and development adaptations through the years.

World of Warcraft has survived a remarkable amount of time. Including itself only a few games can put themselves in the list of such a massively played and perdurable online game. It is clear that even offline games may not have such an impact, especially through almost 10 years of continuous gameplay. Along these years, Blizzard has been faced with the challenge to improve the game and also to keep the qualities people value. Though the game may have been good enough as it was and they could have made something similar to what they did to StarCraft, they decided to improve the game in every aspect they could (e.g. graphics, content, game mechanics). This decision becomes evident given the inherent nature of the game; to progress with others in a world of challenges and adventures. No one can deny that the World of Warcraft soon would be purposeless if new challenges did not appear. Naturally, Blizzard struggled to improve the game and extend it so players feel this progression all along. But along with these modifications other problems emerged, changes were not welcomed in some cases and in another aspects developers had difficulties to adjust to players' speed (e.g. content consumption).

1.3. The word on the streets... of Azeroth.

After some time since the game's release general critiques appeared and along the years more arguments and shared views of the issues have appeared. Players' community critiques gravitate generally around several modifications the game has suffered. Among these comments usually they

refer to the famous *dungeon finder* which has been extended to *raid finder* and also *battleground finder*.

These changes have been studied by Gloster and Colby (2012) who called them “social shortcuts”. The real modification of this developments enabled users to automatically form groups of stranger in order to advance in the game (e.g. go to dungeons and defeat monsters). Before this implementation users had to address other players, dialogue with them and invite them to play. The original dynamic led to permanent groups that finally could lead to friendships in real life. As soon the automated version appeared, the new functional groups emerged and little interaction was present; almost no conversation appeared and every player left as soon as the objective was accomplished.

Other critiques gather around game simplification in terms of leveling, skills and the overall trivialization of quests and dungeons (Hirsh, Mayeda and McIver, 2013). Many users would sum this feeling as a feeling of losing the thrill to play and that the game is a repetitive mechanic interaction. Initially, low difficulty activities such as recollecting low value items were called *farming*. Today, you may see farming (being quests, items, and dungeon or raid currencies) is almost all that players do. The game has being simplified in a repetitive task of acquiring points.

1.4. If the industry is entertainment, motivation is fundamental.

As Blizzard Entertainment proclaims in its name, the main purpose for the World of Warcraft game is to provide an amazing and compelling entertainment experience. So to address the problem of the communities dissatisfaction and the general subscription dropout we will attempt to look at how entertained are players. As we cannot address such a qualitative and abstract phenomena we will take an approach through player’s motivations. Nick Yee has studied different psychological and social phenomena regarding games and particularly MMORPGames (Yee, 2006). Along his studies he has being able to determine different gamer motivations for playing massive multiplayer online role playing

videogames (Yee, 2007). Within his studies it is possible to find that an overall of 10 factors explains the overall motivation to engage on a massively social online game. Over these factors he defined three main components that include them as subcomponents (Figure 1). The achievement component addresses mainly competitive, skilled and progression related elements. Social components in the other hand focus on interaction possibilities. Immersion, as a particularly important component for MMORPGames, gives attention to the generation of a parallel virtual reality and the experience within it.

Figure 1. The subcomponents grouped by the main component they fall under (Yee, 2007).

Achievement	Social	Immersion
Advancement Progress, Power, Accumulation, Status	Socializing Casual Chat, Helping Others, Making Friends	Discovery Exploration, Lore, Finding Hidden Things
Mechanics Numbers, Optimization, Templating, Analysis	Relationship Personal, Self-Disclosure, Find and Give Support	Role-Playing Story Line, Character History, Roles, Fantasy
Competition Challenging Others, Provocation, Domination	Teamwork Collaboration, Groups, Group Achievements	Customization Appearances, Accessories, Style, Color Schemes
		Escapism Relax, Escape from RL, Avoid RL Problems

1.5. Agent Based Modelling and User Experience analysis.

The following approach attempts to model players facing game progression through the effort and social interaction given in its mechanics, features and overall design. The purpose is to understand the impacts of game modifications in players' decisions and how this, in its way, affects the total amount of subscriptions. The main question present here is why World of Warcraft had this specific and critical decay in the last three years. An agent based model approach is proposed as a possible method to answer this question. The reason for this is that an agent based model is able to emulate individual

behavior in an interdependent dynamic with other individuals and, ultimately, reflect the overall collective behavior. Analysis of subscriptions trend is possible if we consider gamer's motivation and the actual gameplay experience and represent it as system with interacting agents.

2 METHODOLOGY

As referenced before, to study the possible impacts of game modifications through the years an agent based model of player motivations is proposed. The model gives the opportunity to test the relevance of hypothetical changes alleged so far and to explore the dynamics of these modifications and players' interests. A simulation approach allows to explore the particular composition that sustains the total subscription and it also permits an assessment of future developments. This analysis of future behavior is not a prediction at all, at most it works as forecast of general possible scenarios. This particular agent based model was built in NetLogo 5.0.4. A more thorough explanation of its structure and dynamics is provided below.

2.1. Agent Based Model of Player Motivations.

The model at hand replicates the interaction between players within a specific game design and its development through 9 years. The agents (players) may decide to play or not to do so considering how satisfied they are with the game features. The final evaluation of the game features is measured through their motivations and interactions within the game. The time scale of the model is set to weekly behavior and the complete simulation runs from game's initial release (WoW Vanilla, November 2004) until today (approximately 471 weeks).

Agents' description

Technically the model, as referenced before, only has one type of agent. Having attributes, behaviors and influences between them Players may be defined as simulated agents. On the other hand the Game does only influence Players and does not qualify technically as an agent, nevertheless we present the Game in this section to explain its properties and to maintain conceptual clarity of the models' overall dynamics.

a) Players

These agents represent real World of Warcraft players that play, interact and evaluate their continuity in the game. Their main attributes are related to psychological attributes and game-related attributes. For the psychological aspect agent have certain motivations to play the game, as already discussed these motivations are achievement and socialization. As for a threshold of acceptable game features they individually have some requirements to assess if these motivations have been satisfied. Through a decision making process they evaluate game features in order of their motivations priority. The result of this decision concludes in staying in the game or stop playing. Interaction with other agents, as one of the main aspect of the game, is socializing to advance in through the virtual world. The amount and type of social interactions have an important weight in evaluating game sociability feature. Agents may have real life friends (RLF) before and during they play game, casual relationships may only be created once both players are online.

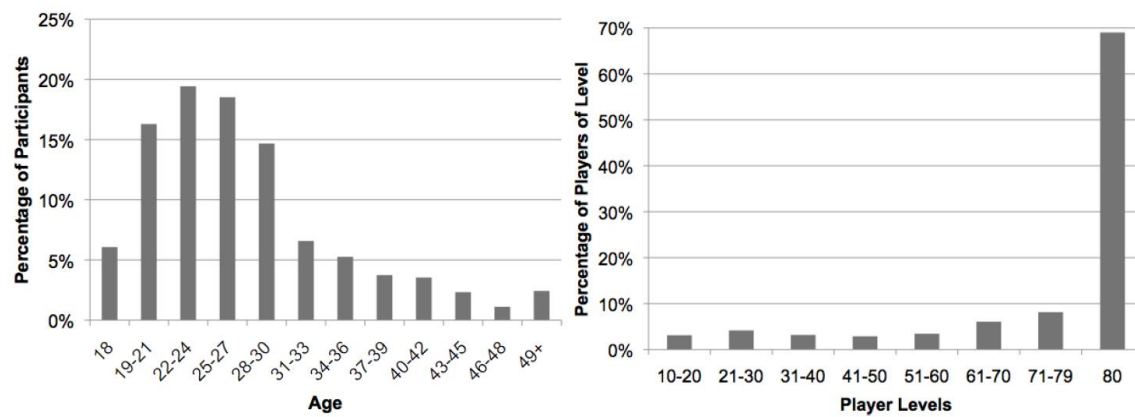
The game related attributes refer to aspects directly involved with the interaction of the game. Two main attributes of this type are interest and game status. The first one is the relative level of satisfaction

withdrawn from the evaluations of game features. Game status is simply a nominal description of their game condition; non-player, player and former-player. Every former-player has the ability to re-enter the game having a probability of doing so proportional to the amount of relationships they keep with active players.

Other relevant attributes, as shown in Table 1, are time and initial cost. Time is the actual resource players may spend to play the game and is used as a proxy of challenge completion requirements. If a player has too much time it will get bored and if it has too short time it will frustrate. At last, initial cost sets a random distribution for game-entry. Not every player knows or has disposition to play immediately after the release of the game so a restriction was set to emulate this behavior.

As usual in model constructions the present ABM includes several simplifications of real players' behavior. Attributes and behaviors as age and player levels were not considered. In the case of players' age the variable was not included with the purpose of keeping to keep the model simple and focusing in the lack of correlation between age and actual game time dedication. For character level, a fundamental aspect of game progress and experience, the model simplifies and makes the assumption that every agent plays at a level 80 challenge standard (Figure 2).

Figure 2. Age distribution and Character level (Likarish et al., 2011).-



b) The Game

As already explained, the game is not really an agent as it does not receive feedback from the players. The interaction is a one way effect to the players and not backwards. In this sense it shall be considered as an exogenous source of influence. Even though it is not an agent it is important to address the main two attributes of the game design: challenge and socialization. Challenge represents every aspect of the game that enforces some difficulty to overcome and that, given the nature of the game, is a requirement or a goal for the player. As a role playing game in essence, the game's difficulty is mainly based in the amount of time and dedication a player may have. Besides Player versus Player interaction the game clearly lacks of any skill requirement. Given this quality the challenge feature is a time requirement for players to accomplish some achievements. On the other hand we have Socialization that is strictly the amount of interaction the game enforces. A higher amount of socialization features represents a game designed for higher amount of social interactions to accomplish some progress in the game. As it shall be seen later, this two parameters will be modified to test the influence of the historic game developments that Blizzard established for the game expansions.

More about social interactions

Casual relationships emerge as players require to form groups and advance further into the game. Several type of in-game relationships are available: "party member", "instance group member", "guild member", "friend" and "real life friend" (Blizzard, 2013). The model presented considers an abstracted categorization of these friendship statuses. Players may have casual or real life friendships, if casual relationships endure they may develop into real friendships which in the model is differentiated by a more durable type of connection. The real life friending trend has been widely for events such as in-

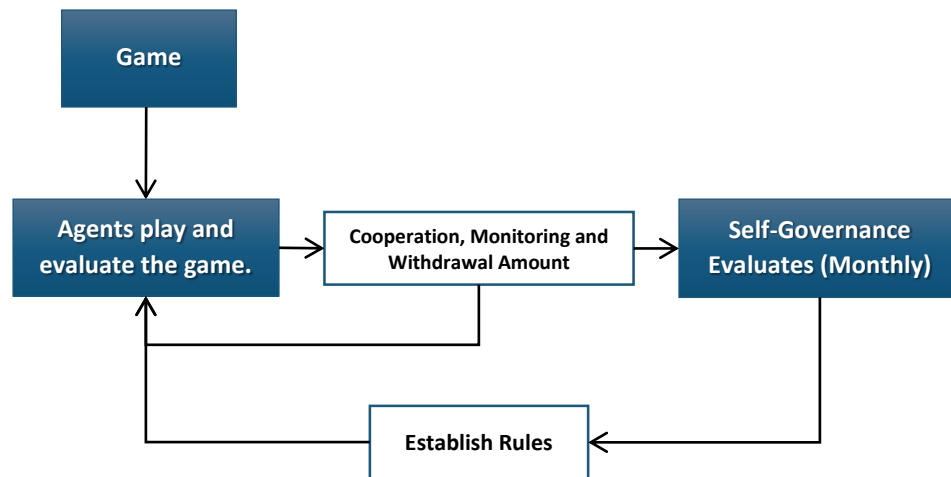
game real marriages between people who met each other playing the game. In fact, real life friending has become a fairly regular issue in World of Warcraft and another games.

2.2. Simulation Process.

The complete simulation process begins with every agent out of the game. Every week non-active player agents, whether new or former player, decide if they want to enter the game according to a specific initial entry cost and friends' influence. Once they are in the game as active players, they progress through the game facing challenges and interacting with other players. These interactions allow to experience the game influenced by its features and it also allows to build relationships among players. To decide if they stop or continue playing, every agent evaluates the game attributes (e.g. challenge and sociability) through their motivations and their final interest. In-game players make this evaluation every four weeks according to a fast and frugal decision tree. The monthly decision behavior is based in most common subscription renewal; a 30 day game time product (Blizzard, 2013).

Agents contrast their need for socialization and challenge according to their motivations. To determine satisfaction at the achievement level they only play the game according to the time they may provide (Debeauvais et al., 2011). If the game requires too much or too less investment to accomplish challenges then the agent gets bored. On the other hand, to assess social satisfaction agents account the amount of interactions they encountered through the week.

Figure 3: Simulation Process flow.-



The motivations selected for the model are the most relevant for a factor component explanation of gaming behavior. Motivations were evenly distributed among the population with a slightly higher probability for achievement need; as achievement seems to be a higher motivation in overall population then all agents also have a minimal higher probability to have achievement as a higher motivation.

Immersion was not included in the analysis giving the difficulty to measure immersion of real players.

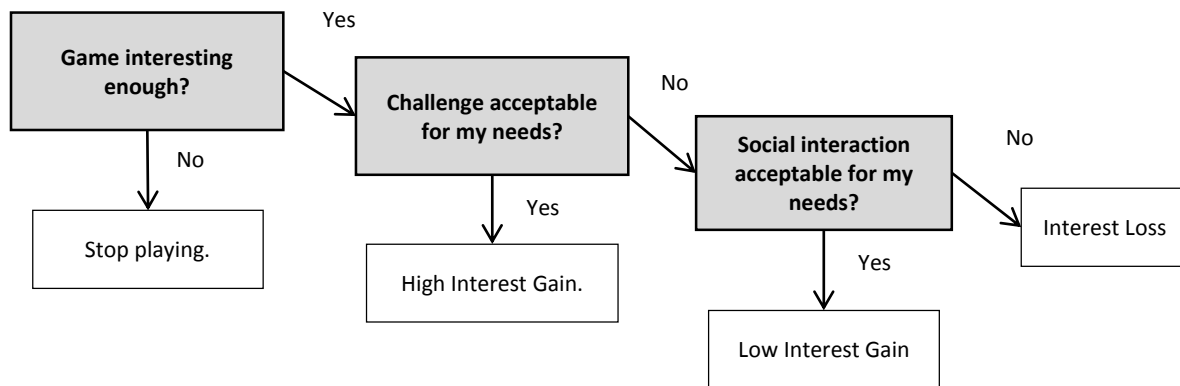
To address the measurement problem several proxy were made to evaluate players thresholds related to challenge and social needs. For achievement motivation challenge is the desired parameter to be satisfying, and for sociability for social motivation. The first game feature was modeled using time as a proxy of dedication. More dedicated players may achieve more (giving that the game is highly linear in difficulty as made clear in Figure 2) and also may get bored easily as there is not enough experiences of achievement after too much time playing. A less dedicated player may get frustrated if it does not the requirements to achieve minimal goals. Social motivation depends strictly of the minimal amount of social interaction wanted, this social interaction is measured in amount of total relationships desired.

Table 1. *ODD Model Overview.-*

Agent	Attribute	Measure
Player	Time (Hours Weekly)	Int [0,70]
	Motivation (mA, mS)	Float [0.0,10.0]
	Real Life Friends	Int [0,999]
	Need (Social, Achievement)	Int [0,10]
	Initial Cost	NNN
Game	Challenge	Int [0,100]
	Sociability	Int [0,100]

Initialization was set with 1000 agents out of the game. Only 3% of the agents had real life friends at the beginning of the simulation. When simulation run within the game expansions scenario the modification where made at intervals of 2 years (as real system modifications).

Figure 3. *Agent decision making: Example with Achievement as higher motivation.-*



As already said, agent decision making in the model is based on a fast and frugal hierarchy. Gigerenzer's (1999) heuristics based tree is a proper modelling tool considering that decisions are withdrawn from easily processed criterions. The tree proposed for the model is built according to agents' highest motivation so its organization varies relative to agents properties. Figure 3 shows an example of the proposed tree with the pertinent questions and their consequences. This structure permits an evaluation where social and achievement motivation may be properties of a single agent, thus motivations are not exclusive and may be present in different levels.

2.2. Validation.

Micro-validation:

Regarding the aspects of individual behavior validation or micro-validation agents were modelled according to several player data from videogames, MMORPGs and particularly World of Warcraft. As already discussed players follow, by a hierarchical decision tree (Gigerenzer, 1999), their motivations through priority. As already discussed, the presence of these motivations has been well

studied by Yee (2007). Players' time was calibrated to average weekly hours dedicated to play the game (Debeauvais et al., 2011).

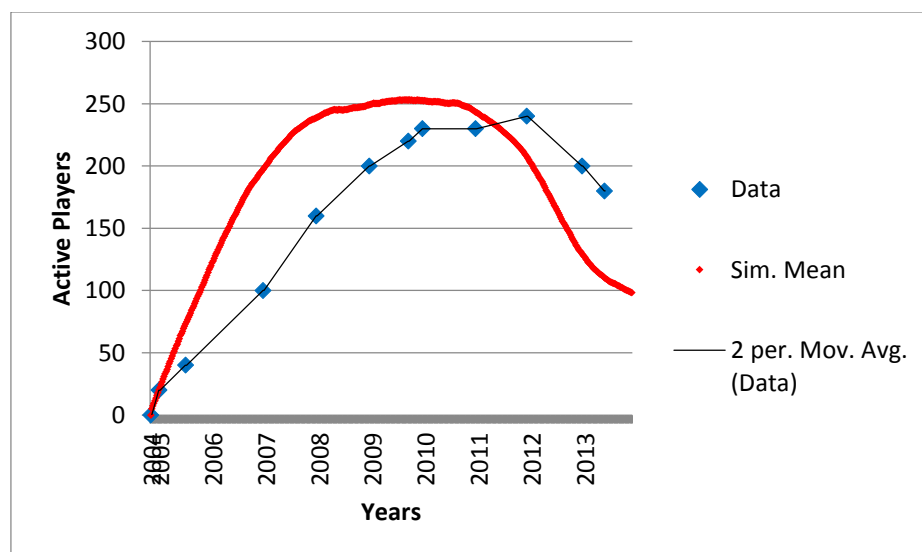
Macro-validation:

As indicators of the model's validity initial game-entry date and subscription time series were used to compare between simulation results and historical data.

Simulated data displays a similar trend as real data. The simulated trend reveals a slight skewedness to the right thus having more players in the game earlier and also beginning the massive drop out before the real drop out. Nevertheless the model seems to replicate fundamental characteristics of the time series within relatively close time spans.

As the simulation ran only with 1000 agents it is evident that is not to scale. Real data in Figure 4 has been adjusted to the simulation scale just for comparison purposes. Maybe put third axis with millions scale.

Figure 4. Average Simulated Subscription versus Historical Data.-



In the case of player's first time playing simulation results also show relative similarity with real data. According to data extracted in a study made by Debeauvais and collaborators (Debeauvais et al., 2011) there is a clear pattern of game entry frequencies (Figure 5). Measurements made to simulation results present a similar histogram (Figure 6). The most different year is the first one (just two months), the reason for this is the model has a simplified game-entry procedure. The model does not include incentives or the ability for agents to foresee coming expansions so there is no "hype" built for new releases. The same occurs in the initial launch of the game, players gradually enter the game while opportunity appears to play it. This gradual and more lineal game-entry behavior seems to be a relatively acceptable simplification to the real game-entry decision making and behavior. We may say this considering that the final distributions of initial game entry are very similar in structure.

Figure 5. Distribution of dates of first playing WoW (Debeauvais et al, 2011).-

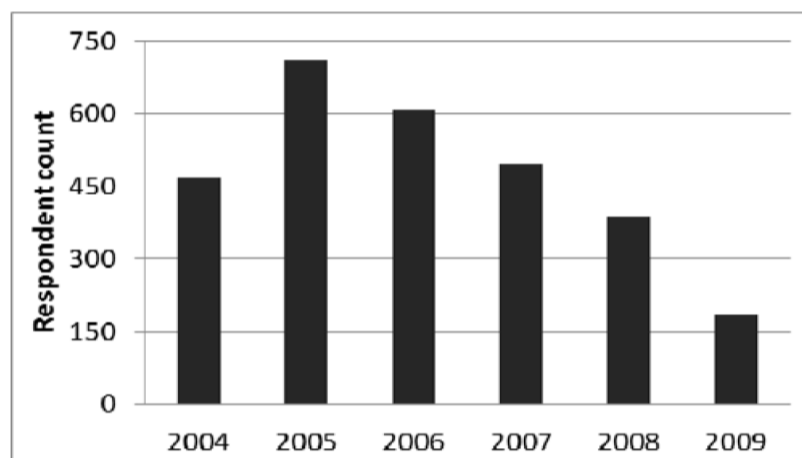
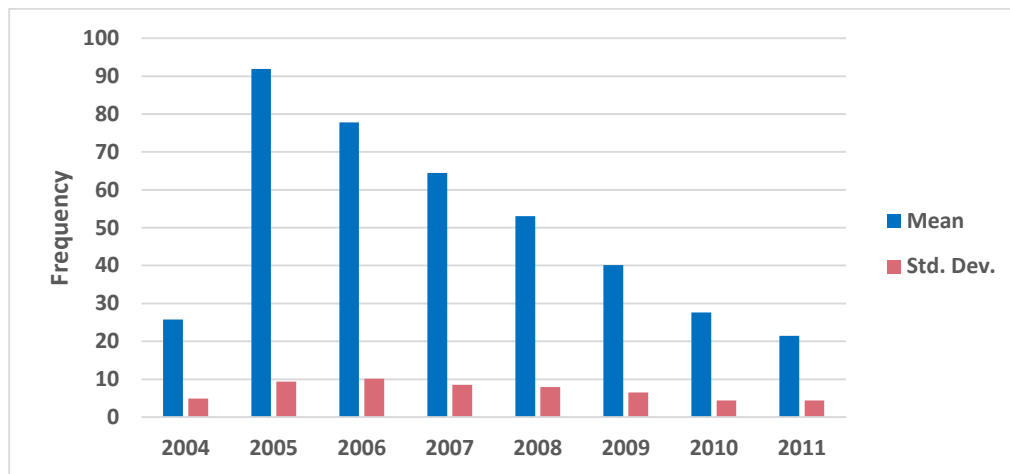


Figure 6. Average Simulated Player Initial Year.-



2.3. Sensitivity Analysis

To test model construction and the impact of parameters on the final variability several sensitivity analysis were made. The main purposes of these analysis was to detect the relevance of the parameters and to identify the influence of the hypothetical game modification in the overall subscription. The particular approach for all the analysis provided was a Local Sensitivity Analysis. Results of the LSA that show low variability influence are presented first, followed by parameters that presented high influence in subscriptions behavior.

Parameters with low or insignificant impact in overall behavior.-

An important analysis to assess the influence of the proposed hypothetical game modifications was the sensitivity analysis of challenge and socialization parameters. The analysis was made through 30 runs per value and it went through the whole range of the parameters in intervals of 10%. These tests were

made with a fixed value through all the simulated years. Results in Figures 7 and 8 give a fair perspective of a low significance in these parameters impact in the overall subscription behavior.

Figure 7. Challenge modification impact in Subscription.-

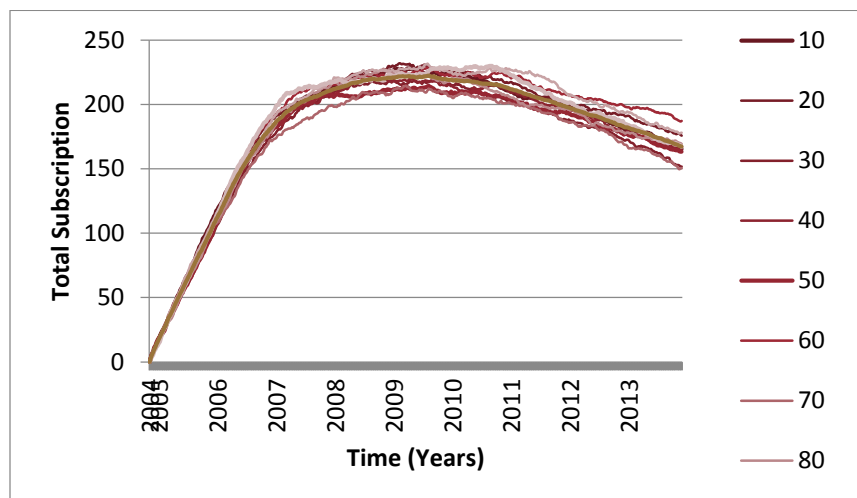
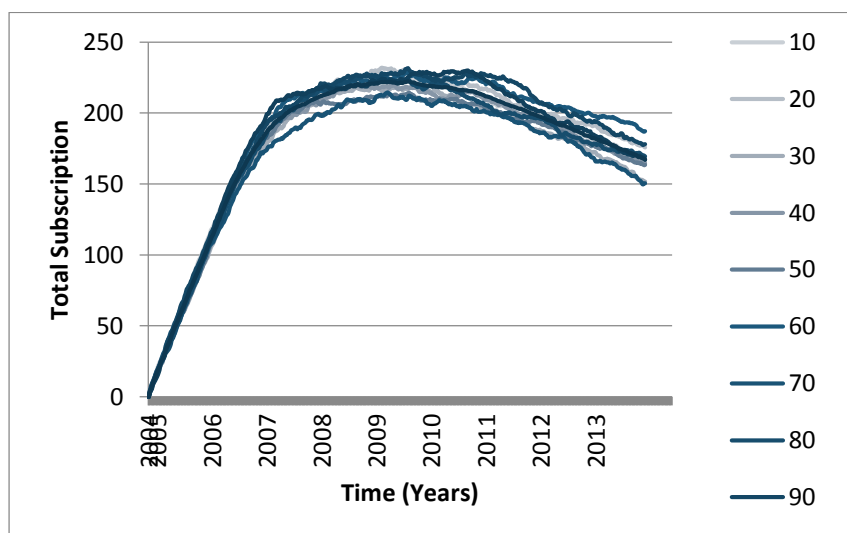


Figure 8. Sociability modification impact in Subscription.-



Another parameter sweeping analysis that didn't throw significant impact in the overall behavior of the model is "Real life friends". Inclusion of initial real life friends seems not to be affecting the overall subscription behavior. This is highly counterintuitive given that higher initial connectivity should incentive a faster migration into the game. The reduced effect of this parameter is probably being affected by the simplified process to enter the game.

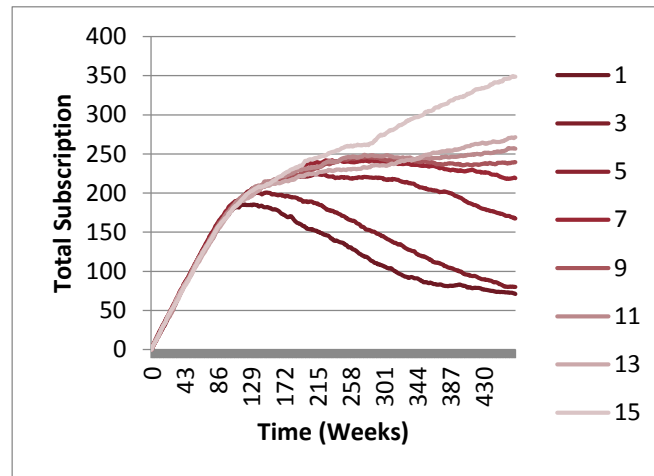
Parameters with high or significant impact in overall behavior.-

Among all the LSA made few parameters showed significant influence in the final outputs of the model in general. This parameters would need an additional attention in order to calibrate them accordingly to real data in a way to restrict the whole liberty grades of models behavior into a valid scenario. The parameters that appear to have more influence in subscription variability we have: *friend duration*, *average initial cost* and *initial population size*.

a) Friend factor or minimal relationships given by Sociability (Game Feature).-

Friend factor could be considered as an additional aspect of the game sociability feature. It consists in the amount of friends that are generated within gameplay, when active players engage they generate relationships (that as seen before can turn into real life friendships). The power of these relationships is given by the friend duration. This parameter clearly affects the social motivation and behavior of agents. LSA shows that it does not only affect significantly the overall subscription but it also finds a tipping point at certain level. As shown in Figure 9 changes in the variable give important different outcomes, the time series shown when Friend Factor is set at 13 reveals a particular different behavior; subscription seems to go high and not having any feedback agency that restricts this ongoing growth.

Figure 9. Subscription trends according to Friend factor from 1 to 15.-

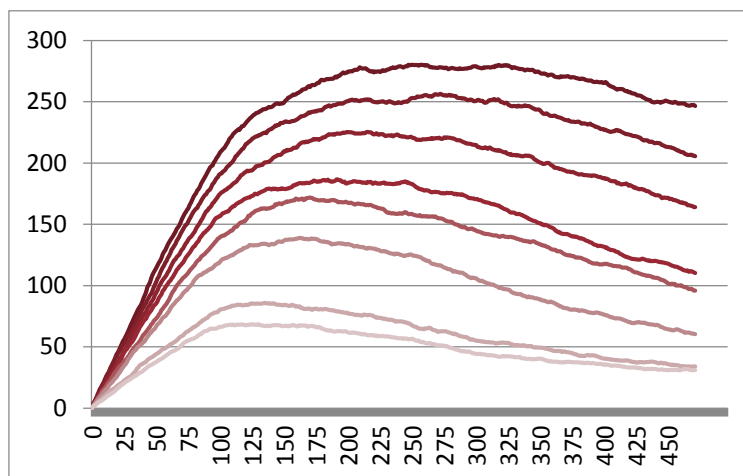


It would be critical to assess the real value or behavior of the friending dynamics. Finding that a “friend factor” is actually higher than the tipping point would be a pretty solid argument to demonstrate the whole model is not valid.

b) Average Initial cost.-

Average initial cost also seems to have an important role in total subscription variation. The particular influence of this parameter seems to be a proportional and direct relationship between the cost of entering and the actual quantity of players inside. According to what would be expected to happen the final importance of the average initial cost variable is its role in the process of entering the game. Having a distribution with less costs to begin playing allows more agents to enter faster. As discussed further on, the entrance procedure is critical and should be carefully studied.

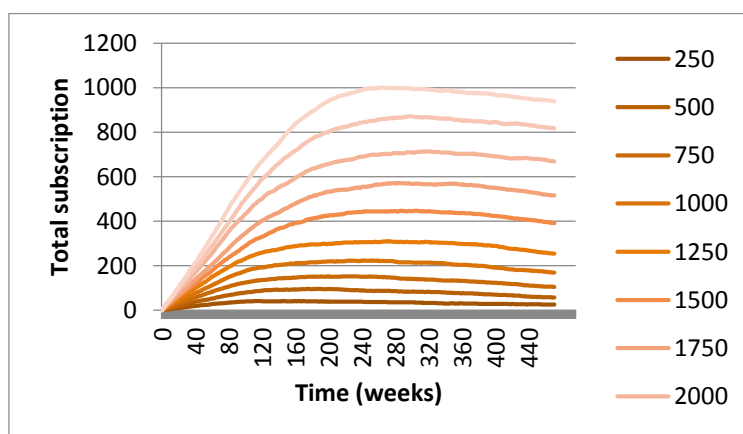
Figure 10. Subscription trends according to Initial Population Size.-



c) *Initial Population Size.-*

As expected, a higher amount of initial population just influences in a proportional increment in the overall in-game population. Though smaller populations have a flattened trend curve the behavior pattern is similar in all populations analyzed.

Figure 11. Subscription trends according to Initial Population Size.-

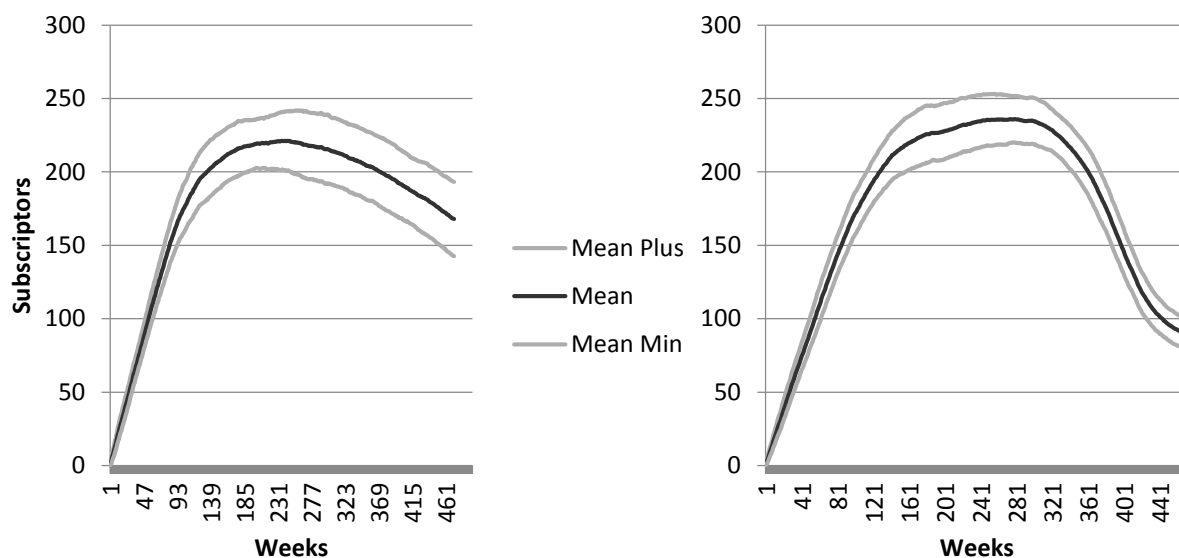


3 RESULTS

3.1. Subscription behavior and composition.-

Comparison between simulations with and without expansions (e.g. game modifications) indicates that the subscription behavior is affected by the presence of changes in the games properties. The general tendency seems to be relatively similar but the abrupt decay when modifications are applied displays an important difference towards the end. Considering game modifications the portion of gamers' profile changes significantly. From a natural decay due to boredom in the non-modified scenario, we may perceive how the expansion modifications maintain a stable period of time before an abrupt loss of almost 50% of the total active players (Figure 12). After the release of the "Wrath of the Lich King" expansion (Third one, year 2008) gamers with social priority begin to migrate. On the other hand achievers begin to remain longer and the subscription does not perceive a "downsize" immediately after this expansion. The new challenge configuration gets acceptable enough for the players and allows newcomers to adjust and stay.

Figure 12. Subscription without expansion modifications (left side) and with historical the expansion modifications (right side).-



Composition of Subscription: Time series of Achievement and Social Motivation.

Particular compositions of motivations behavior is also relevant. Differences between both total subscriptions are clearly explained by their components; variations in achievement and social motivations. In the “natural decay” scenario social motivation is the main contributor to the total amount of active players. Around week number 100 (approximately second year) achievers begin to leave the game. On the other hand agents with social motivation keep longer playing the game. An effect of “social inertia” may be present here and regardless of achievers dropping out the already significant amount of players within the game make social agents to stay in. The particular behaviors of this “natural decay” scenario is illustrated in Figure 13.

When analyzing the simulation with game modifications roles seem to change (Figure 14); social motivation loses a huge portion of participation at week number 180 and achievement seems to thrive it

collapses around week number 325. Social interaction seekers receive a high impact in their interest with the first game modification and immediately begins to decrease. On the other hand achievers do not stop growing until a certain threshold is reached and interest regarding challenge and progress seems to be lost.

Figure 13. Subscription trends and Motivation composition without Modifications.-

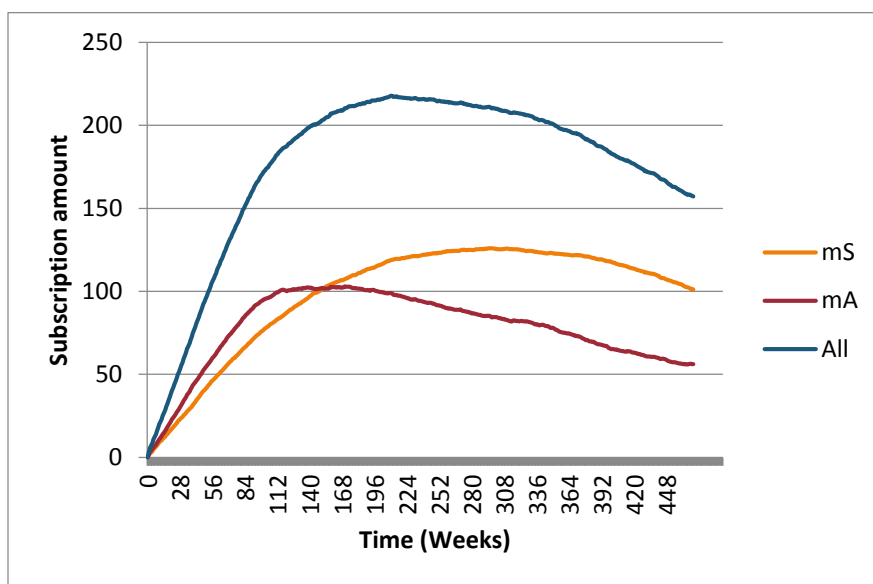
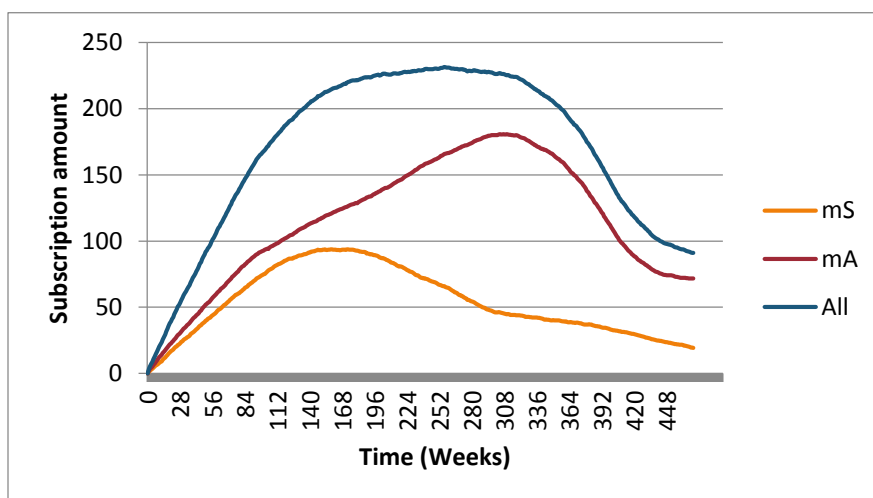


Figure 14. Subscription trends and Motivation composition without Modifications.-



Modifications presented in year 2010's expansion seem to be a tipping point regarding achievement motivated players. From this point on challenge threshold seems not to be enough to sustain a large amount of satisfied players. The abrupt descent goes along with the already decaying social motivation population. The aggregated result builds a composition of active in-game player subscription that matches the overall tendency of real data.

3.2. Forecasting.-

As the model could fairly replicate some of the target complex adaptive system some enquires regarding future projections were made. Activision – Blizzard is planning to launch a new expansion called “Warlords of Draenor”. Several scenarios (each composed of different challenge and socialization compositions) were tested looking for the best case scenario. Results show that game features development should try to focus on social interaction (e.g. requirements or bonus for non-automatized dungeon group creation, enhance professions importance, obligatory group quests) as much as they are able to and keep the same amount of achievement structure (e.g. experience points, item drop rates , high level dungeon and raid completion).

The average simulation forecast (Figure 15) shows the mean time series of 30 runs with the best composition found; challenge = 15, sociability = 95. Analysis of standard deviation of these time series show how achievement motivation has a particular rise of deviations between year 2012 and 2013. This peak is most probably due that the drop out seems to be harder in some runs than other.

Figure 15. Average Simulation Forecast (Challenge=15, Sociability=95).-

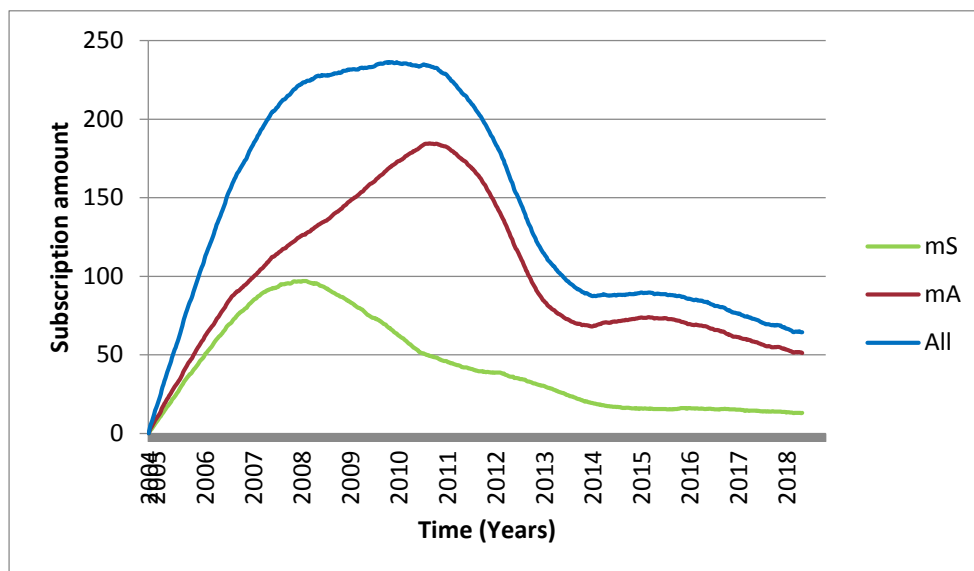
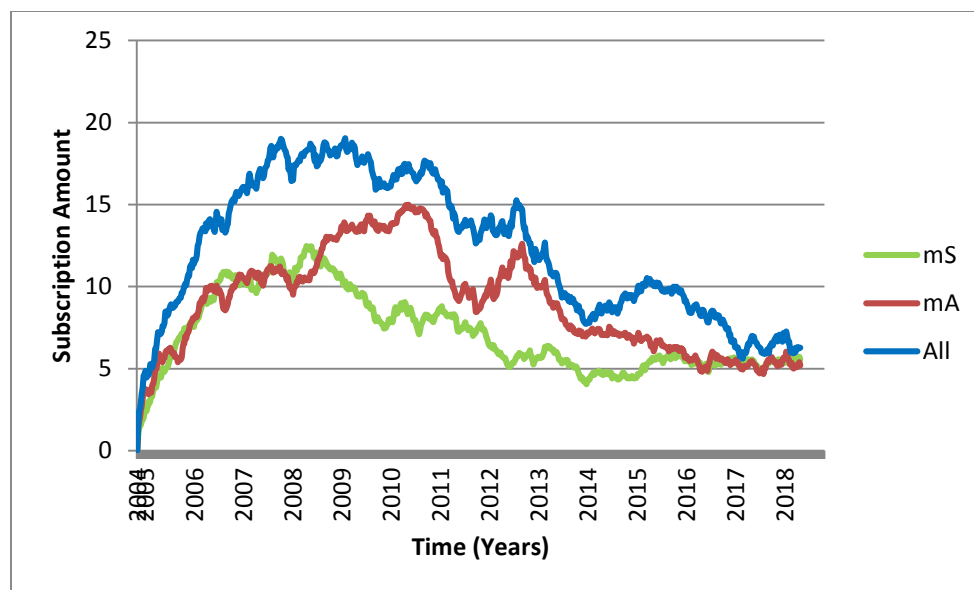


Figure 16. Simulation Forecast Standard Deviation (Challenge=15, Sociability=95).-



4 CONCLUSIONS

Model results show how gamer's motivation modeled as a fast and frugal decision tree may replicate the total active participation. Analysis provides evidence of the impact of the proposed hypothetical game changes perceived by the community. Time series of the game display a congruent behavior with real data showing that the overall behavior of WoW active players may be explained as continuous player's experience and evaluation with discrete game modifications. Players with Achievement as high priority are those who compose the majority of the gamer's subscription after modifications were implemented. Achievement players also show a high sensitivity to game feature changes, whereas social motivated ones are more robust. The major presence of achievers is explained given that the differences in the challenge feature allow newcomers to feel adequate difficulty that they couldn't find before the modification. On the other hand, those with a priority on Socialization seem to leave the game after the social features of the game have been altered. The general results show a significant difference with a non-modified game were the Social motivation is the main foundation for active players' subscription (social inertia).

Results in the forecasting experiments indicate that sociability should be a priority for following developments. Giving focus to social aspects of the games would enhance linkages between players. Challenge features should be kept the same.

5 DISCUSSION

This model shows the relevance of simple modeling and the possibility to assess highly complex social interactions within a simple model (phase transition of parameters). Slight changes in the model show important differences in the composition and behavior. A systematic analysis of these differences, even in this simple model, may provide new information and conclusions about the target complex adaptive system. In this particular case consideration of individual motivations in a changing environment displays information about the distribution and behavior of collective interactions. As seen in subscription motivation composition and forecasting results, the information provides a more comprehensive understanding of the real system and the possibility to assess future developments and product design decision making.

Particularly the results regarding motivations participation in the total subscription are an important hint for Blizzard's developers. It may be possible that total subscription is dependent of particular elements that maintain a huge amount of users satisfied. In this case the challenge threshold and the social shortcuts seems to be two important circumstances that show how specific modification may alter the whole situation. Though results from the forecast experiment are just a guidance it is important to evaluate in what conditions challenge should be kept intact. The model considers that more hardcore gamers already left and that they also have an improbable chance to enter the game soon enough. Development of higher challenge in the next expansions could have a positive impact in subscription if the company manages to get old hardcore gamers to play again. Although possible to do, a marketing move like that would certainly have the odds against it.

Attempts to extend the model for a better representation real players and the videogame market several demographic aspects should be considered. As the model makes a proposal to analyze gaming

experience and product development, it would be interesting to apply it to other games and communities.

Future approaches should consider analyzing the artificial network as a possible tool for validation. To complete an approach of Nick Yee's analysis of motivation the third main factor (e.g. immersion) should be included. Immersion is a highly personal and subjective dimension and clearly demands some challenges for inclusion in the model. Some possible proxies for this attribute could be also dependent in social interaction or game automation. In the case of social interaction, Immersion be generated by how many other players really behave as their characters' role (e.g. orc warriors or elf mages) and therefore generate an atmosphere of connection with the fantasy world. On the other hand, high amount of game automation (e.g. instant teleports to travel) or highly abstracted user interfaces reduce the experience of "living" in an alternate world.

Several other calibrations should be addressed to achieve a more comprehensive and valid model. Adjustments such as the process of deciding when to enter the game for the first time should be an important addition to the model's overall dynamic.

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