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Going out of business: Auction house behavior in the Massively Multi-player Online Game *Glitch* ☆

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ABSTRACT

The in-game economies of Massively Multi-player Online Games are complex systems that have to be carefully designed and managed. This paper presents the results of an analysis of auction house data from the Massively Multi-player Online Games *Glitch*, across a 14 month period, the entire lifetime of the game. The data comprise almost 3 million data points, covering over 20,000 unique players and more than 650 products. Furthermore, an interactive visualization, based on Sankey flow diagrams, is presented which shows the proportion of the different clusters across each time bin, as well as the flow of players between clusters. The diagram allows evaluation of migration of players between clusters as a function of time, as well as a churn analysis. The presented work provides a template analysis and visualization model for progression-based or temporal-based analysis of player behavior broadly applicable to digital games.

1. Introduction

Online games form a major component of the games industry, and have expanded strongly in terms of market share, variety and market penetration in recent years, notably due to the increasing availability of mobile platforms and the introduction of Free-to-Play (F2P) business models by the interactive entertainment industry [15,29,50,51].

Of the wide variety of online games, Massively Multi-player Online Games (MMOGs), and the various derivatives, are unique in that these games see thousands or more players interacting within the same virtual environment [21,22,42,46,64]. The games can support complex virtual societies that include in-game economies [3,8]. The economic systems operating inside virtual worlds, as well as the economics surrounding virtual worlds and the trade occurring between the real world and the virtual, e.g. purchasing of in-game currency using real-world currency, or vise-versa, have formed the basis for research interest from industry and academia, for the latter notably from the perspective of behavioral economics and sociology. This is partly because of the sheer size of these virtual markets, the unique challenges imposed by virtual property rights [7,9,22], social and societal aspects [16] even subversive criminal activity within these worlds, notably gold farming [1,19,25]. MMOGs form semi-controlled/contained environments for economic and behavioral research [24,26,43,65], and thereby offer an environment for examining human behavior, e.g. for socio-economic experimentation. This is an additional factor in driving research interest.

The work presented here is situated within the domain of economics-focused game analytics, focusing on combining dimensionality reduction of economic data with temporal pattern identification. The fundamental research question or motivation driving the work is the question of whether or not players change their behavior as a function of time when it comes to their interaction with an in-game economy of a MMOG, and how their interaction with the economic system can be modeled and profiled. This motivation can be split into two goals:

(1) To provide a longitudinal analysis of the auction house data from the F2P, browser-based MMOG *Glitch* (Fig. 1) [6] with the purpose of uncovering patterns in the player behavior in connection with the in-game economy of the game. The analysis combines dimensionality reduction techniques with temporal analysis to enable the definition of clusters of

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player behavior, and observe how these evolve across time. The motivation for the first goal departs from most previous work in the domain as it does not attempt to fit, e.g. a financial theory to a MMOG market, test specific hypotheses, or examine the relationship between real-world and virtual-world economies, but rather works in a data-driven, explorative fashion, focusing on the players.

(2) To develop an interactive visualization of behavioral profiles which account for temporal dynamics, which additionally enables non-experts to interact with the data and results from the analysis.
The motivation for the second goal is the increasing need in the industry (and game science) for flexible, dynamic visualization and analysis tools [11–14]. Data visualization is a well-established field in its own right [34], but the history of applying theories and techniques from data visualization to the specific context of game analytics is more recent [23].

2. Contribution

Three primary contributions of the work presented here can be summarized as follows:

(1) A description of the *Glitch* economy as it evolves over time, which adds a first-time *game lifetime* view on key economic indicators. This provides insights into the online economy of an MMOG across its lifetime, including novel visualizations of key economic data. Previous investigations of online game economies have not targeted the browser-based class of MMOGs, having instead mainly focused on major commercial MMOGs.

(2) A presentation and evaluation of a new method for progression-based analysis of player behavior, showing how *Glitch* players utilized the auction house, across a 14 month time period. The data comprise almost 3 million data points, over 20,000 unique players and more than 650 products. The results show that four behavioral profiles (Casual, Moderate, Forum, Hardcore) are relatively consistent in relative proportion and temporally. This holds despite varying player populations in *Glitch* over the studied time frame, notably a reduction in the player base from 4632 unique monthly players to just 723 in the final month before *Glitch* closed. Only the Hardcore cluster consistently sees a large proportion of the constituent players migrating to the same behavioral cluster (Hardcore) in succeeding mounts, whereas churn rates are high for the Casual cluster.

(3) A web-based interactive Sankey diagram, which shows the proportion of the different behavioral profiles (clusters of behavior) across each time bin, as well as the flow of players between clusters. The diagram allows evaluation of migration of players between clusters as a function of time, as well as a churn analysis (http://powerful-meadow-8588.herokuapp.com/). Sankey diagrams (Fig. 2) form a type of a flow diagram, and are commonly used for analyses and visualization of energy, liquids, materials or costs of transfers between nodes or processes [27,28].

In combination, the analysis and Sankey diagram-based visualization combine the considerations of behavioral economic analyses with data visualization, and provide a template model for conducting a progression-based or temporal-based analysis of player behavior in any digital game, beyond MMOGs, across any dimension of a player behavior – not limited to economic data.

3. Previous work

Previous work on in-game economics is diverse, stems from both academia, the game industry and associated industries, reflecting the underlying diversity in games and the economic models that are utilized across game genres.

In this section the focus will be on drawing the general outlines of research on in-game economies, but in the interest of maintaining the scope, with a focus on the previous work most relevant to the study presented here, i.e. in-game trading in MMOGs. This section is not intended to be a full review of all work on in-game

Fig. 1. Screenshot from the MMOG *Glitch*, showing a player's property.