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# Influence of Gameplay on Skill in Halo Reach

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**Abstract**

We study the question of how skill develops in video game through a rating called TrueSkill. In a previous paper [1] we used the skill ratings from 7 months of games from over 3 million players to look at how play intensity, breaks in play, other titles played, and skill change over time affect skill. In this paper, we briefly summarize our findings and discuss how we plan to continue our research.

**Keywords**

Games, Analytics, Game Usage, Player Progression

**ACM Classification Keywords**

K.8.0 [Personal Computing]: Games.

**General Terms**

Human Factors, Measurement.

**Introduction**

In this paper we present a brief overview of player game characteristics in Halo Reach. We discuss play intensity and play patterns with respect to skill development. We present a general method of our analysis that can be applied to other games. We conclude with some of our future plans for mining game-player data.

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### Analysis of Skill Data

Step 1: Select a population of players. For our Halo study, we selected a cohort of 3.2 million Halo Reach players on Xbox Live who started playing the game in its first week of release.

Step 2: If necessary, sample the population of players and ensure that the sample is representative. In our study we used the complete population of players in this cohort, and our dataset had every match played by that population.

Step 3: Divide the population into groups and plot the development of the dependent variable over time. For example, when plotting the players' skill in the charts, we took the median skill at every point along the x-axis for each group in order to reduce the bias that would otherwise occur when using the mean.

Step 4: Convert the time series into a symbolic representation to correlate with other factors, for example retention.

Repeat steps 1–4 as needed for any other dependent variables of interest.

### Skill in Halo Reach

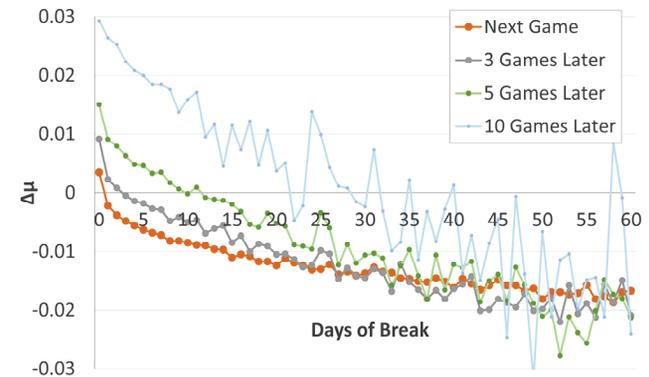
For our study, we selected a cohort of 3.2 million Halo Reach players who started playing the game in its first week of release. We selected this cohort of players to control for the time when a person starts playing Halo Reach. To quantify the skill of each player we used the TrueSkill [2] rating, which is used for matchmaking across numerous Xbox titles. We then analyzed the skill time series for different groups of players in the cohort. Our findings are presented in detail in our CHI 2013 [1] paper and briefly summarized below:

**Play Intensity.** We observed that on a *per game* basis, those who play 4–8 games per week seem to do best. *Over time*, we observed that players who play more than 8 games per week can eventually surpass the less frequent players.

**Breaks in Play.** Figure 1 shows behaviors that players exhibit after breaks. The change in skill from before the break to after the break is illustrated by the 4 lines representing the next 1, 3, 5, and 10 matches after the break. When players are not taking breaks (breaks of 0 days), skill generally increases, as evidenced by the climbing intercepts on the y-axis. Breaks of 1–2 days correlate with a small drop in skill in the next match played after the break, but have little long-term effect. Longer breaks correlate with larger skill decreases, but the relationship is not linear. More concretely, a 30 day break correlates with a skill drop of 10 matches of play; this is shown by the intersection of the 10 games later line with the x-axis. Thus, the amount of time required to regain skill following a 30 day break is only about 3 hours of gameplay (matches are typically 15 minutes).

**Other Titles Played.** Players who did not play Halo 3 previously were less skilled but gained skill at about the same rate as everyone else in Halo Reach. The number of game titles played before also appeared to have an effect on skill development and that effect may even be stronger than the skill transfer from individual titles.

**Skill Change and Retention.** By converting the skill time-series into a symbolic representation using SAX (Symbolic Aggregate approxIMATION) [3], we observed that players who improved in the first 100 games actually ended up playing fewer games in the 7 month period than players with declining skill. We believe two factors play a role in this effect: 1) players that improve are more aggressive and hardcore gamers, who switch to other games earlier; 2) a skill improvement is not obvious to the player, but they do notice themselves performing worse against (unknown to them) stronger opponents, and the extra challenge may cause frustration, provoking them to quit.



**Figure 1.** Skill change after different lengths of breaks for the next match, 3 matches after, 5 matches after, and 10 matches after the break.

## Next Steps

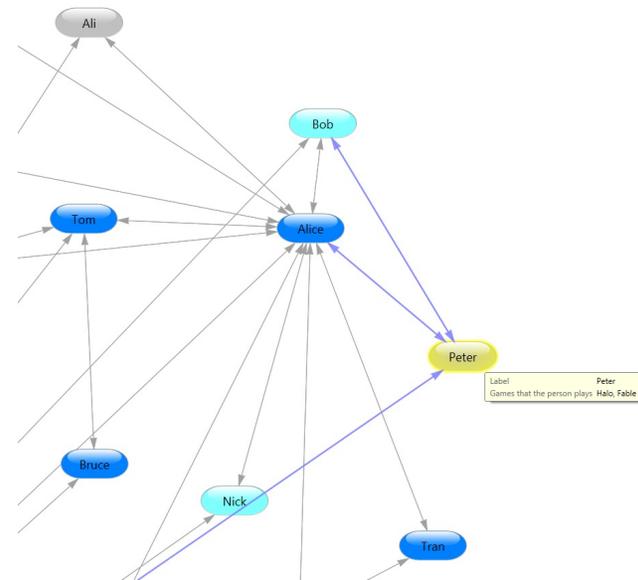
In the previous sections, we gave examples of mining data to obtain insights into how players develop skill within a game. Other aspects for which we mine data are activity, attrition, and tenure within in games. Our current and future work focuses on the following topics:

*Social network analysis of game players:* With the increased connectedness of games being played online it is important to understand from a social network perspective the various connections and ties between players. Using an infrastructure like Xbox Live, users can play online against (or with) other users. The notion of a friend or frequent player exists in such networks. For example as in Figure 2, it would be possible to build a social network of who plays with whom and how frequently and then use the network to identify key influencers using time as a vector. For example, 2 weeks after "Peter" begins to play Halo, if two-thirds of his friend network started playing Halo (say significantly higher than for other players), we can identify Peter as a key influencer. Additionally we can analyze the influence of geographic distribution on social networks.

*Mining forums to identify pain points:* Gamers have dedicated forums where several opinions about games are discussed in great detail. To begin with, we plan to mine some of these forums to perform various analysis (like sentiment analysis) to identify which aspects or features of the game cause the users significant pain.

*Player retention:* What in-game environmental factors affect player retention? There has been a lot of work on player retention in the community [4] but we intend to focus more on in-game characteristics and experience,

like for example in a racing game, competing in a tough racing circuit early on can lead to disappointment in the game which can cause a user to quit.



**Figure 2.** Example Social Network of Halo players

## Biographies

**Jeff Huang** is an information science PhD candidate at the University of Washington in Seattle. His research areas are in information retrieval and human-computer interaction, specifically in decoding the fundamental human behavior inherent in large-scale data. His dissertation develops new techniques to collect users' mouse cursor activity in web search to model users' attention and identify relevant search results. He co-founded a Techstars-backed company that makes geolocation mobile games.

**Thomas Zimmermann** is a researcher in the Research in Software Engineering Group at Microsoft Research. His research interests include empirical software engineering, computer games, recommender systems, and social networking. He is best known for his work on systematic mining of version archives and bug databases to conduct empirical studies and to build tools to support developers and managers.

**Nachiappan Nagappan** is a principal researcher at Microsoft Research at Redmond, WA. He works in empirical software engineering and is very interested in applying data analytics to game data from a software engineering perspective.

**Bruce Philips** joined the Microsoft Game Studios User Research group in 2001 and has worked on a wide variety of games, including Mech Assault, Voodoo Vince, and Halo: Reach. Bruce recently moved into a full-time analyst role helping to define the next generation of analytic-based entertainment research.

**Chuck Harrison** joined the Microsoft Game Studios User Research group in 2005. During his MGS tenure, Chuck has helped ship some of Xbox Live Arcade's most successful titles, some web-based games, and retail hits such as Halo Wars, Alan Wake and Joy Ride for Kinect. Chuck's team is currently working on a wide variety of games from upcoming Windows-based

releases, the next round of XBLA hits, major franchises like Gears of War, and some exciting new Kinect titles. Chuck has over 15 years of user research experience ranging from consumer products to back office and business applications. Before joining Microsoft, Chuck worked at several other high tech companies such as Siebel, BMC, Intel, & Netscape (in the early 90's). Over the years, Chuck has presented research at several HCI and game related conferences and has published researched focused articles and book chapters.

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