Game Mining

or

The Three "Don't"s for Success in Gaming

Pieter Spronck

Tilburg University, The Netherlands
Cognitive Science & Artificial Intelligence
WHICH PICTURE COMES NEXT?

Educational Games For Kids

Pull back the spring to the yellow, green or the red light. How far does the magnet travel in each case?
That’s right, keep picking up trash, do-gooder. You know who else squats all over town? My cat.
While Playing A Game...

• The player is highly engaged
• The player is highly interactive
• The player generates a huge amount of data of a high variety
  – Interaction data
  – Decision-making data
  – Conversational data
  – Behavioral data
  – Data on physical abilities
  – Data on mental abilities
GameRefinery’s Patented Analysis Model

**DATABASE**

We have a database of 7000+ mobile game analyses...

**FEATURES**

...and for each we track over 160 features

**REVENUE POTENTIAL**

75

"How well the feature set corresponds to the market trends"

The more differentiating features and feature combos the game has, the higher the revenue potential

**DATA-ANALYSIS**

Data model analyzes which features and their combinations differentiate top-performing games from the others

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Game Analytics: Maximizing the Value of Player Data

Magy Seif El-Nasr
Anders Drachen
Alessandro Canossa
Editors

Game Analytics: How to Predict Churn in WoW?

Free Training | March 29th 2018 | Pierre Pfennig

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Game Data Analysis – Tools and Methods

A data-driven approach to video game production

Coupant Thibault

PACKT
Game Analytics

Group vs. individual
Mob killing!
Building a huge castle!
Digging for treasure!
Constructing machinery!
Capture the Flag!
Griefing
The effect of player attributes on gameplay

Shoshannah Tekofsky
Pieter Spronck
THANK YOU BATTLEFIELDERS FOR 13K SUBMISSIONS
Collected Data:
1. Player name
2. 100-item IPIP
3. Age
4. Country of residence
5. Gaming platform
6. Credits
Personality and play style:
- Conscientiousness relates to speed
- Unlock score relates to multiple personality dimensions
- Work ethic relates to performance
• Age explains ~45% of variance in play style
• Older players focus more on the game's goals
• Older players are less successful at achieving the game's goals
• Effect sizes are very high for age groups
Age and Effectiveness

• For most features, players peak in their early twenties
• Example: deaths per kill
  • In their early twenties, they start lower (intercept)
  • For all age groups the value decreases over time, more rapidly for elder players (slope)
• But 20-somethings will always outperform their elders
The First "Don't" for Success in Gaming

Don't Be Too Old
The effect of culture on gameplay

Marjolein de Vries
Mattheus Bialaz
Shoshannah Tekofsky
Pieter Spronck
"The question [whether Japanese or Western RPGs are better] is a matter of taste and cultural background... The Japanese favor togetherness, hard work, and the telling of a good mythical tale. Western countries often value strength, independence, and freedom." (Lindsey Weedston)
Hofstede's Cultural Dimensions

- Geert Hofstede, Dutch Management Researcher
- Data from 100,000 IBM employees, 50 countries, 3 regions
- Distinguished 5 (later 6) dimensions
  - Individualism vs. Collectivism
    - Independence and individual rewards vs. dependence and group rewards
  - Uncertainty Avoidance
  - Power Distance
    - To what extent inequality is considered "normal"
  - Masculinity vs. Femininity
    - Assertive, ambitious, and competitive vs. supportive, nurturing, and deferent
  - Long-term vs. Short-term Orientation
  - Indulgence vs. Restraint (was added later)
Individualism vs. Collectivism
Is Play Style Influenced by Culture?

• Competitiveness
  – Masculinity vs. femininity
  – Competition is at the core of many (online) games, in particular FPS games

• Cooperation
  – Individualism vs. collectivism
  – Valuing common goals and supporting others
  – Cooperation and socializing are often listed by (online) gamers as an important quality

• Tactical Choices
  – Related to several of Hofstede's dimensions
    • Power distance
    • Uncertainty avoidance
    • Long-term vs. short-term orientation
  – Weapon/vehicle choices, mission approaches
Selection Criteria

- Age in range 12-65
- Total play time > 0
- Country of residence with at least 200 eligible participants
- Total 7126 participants from 8 countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>393</td>
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<td>Canada</td>
<td>485</td>
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<tr>
<td>Finland</td>
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<td>Germany</td>
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<tr>
<td>Netherlands</td>
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<tr>
<td>Sweden</td>
<td>360</td>
</tr>
<tr>
<td>UK</td>
<td>1083</td>
</tr>
<tr>
<td>US</td>
<td>3948</td>
</tr>
</tbody>
</table>
### Features

#### Competitiveness
- Kills/ Deaths ratio
- Wins/ Losses ratio
- Flag Defender Ribbons*
- Flag Attacker Ribbons*
- MVP Ribbons*
- Combat Efficiency Ribbons*
- Accuracy Ribbons*
- Melee Ribbons*
- Number of Dog Tags*
- Points for Capturing Flags*
- Points for Defending Flags*

#### Cooperation
- Savior Ribbons*
- Avenger Ribbons*
- MCOM Attacker Ribbon*
- MCOM Defend Kills*
- Laser Designation Ribbons*
- Surveillance Ribbons*
- Maintenance Ribbons*
- Resupply Ribbons*
- Beacon Spawn Ribbons*
- Resupplies*
- Heals*
- Repairs*
- Revives*
- MAV Spots*
- UGS Spots*

#### Tactical Choices
- Transport Warfare Ribbons*
- Armored Warfare Ribbons*
- Air Warfare Ribbons*
- Time Spent in Vehicles*
- AAV-7A1 Amtrac Time*
- HMMWV Time*
- A-10 Thunderbolt II Time*
- C4 Planted*
- Mortar Shots*
- Grenade Shots*
- Claymore Shots*

* per total time played
<table>
<thead>
<tr>
<th>Competitiveness</th>
<th>F</th>
<th>η</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kills/ Deaths ratio</td>
<td>4.93</td>
<td>.005</td>
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<tr>
<td>Wins/ Losses ratio</td>
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<td>&lt;.001</td>
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<td>Flag Defender Ribbons/Total Time</td>
<td>2.50</td>
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<td>.014</td>
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<td>Flag Attacker Ribbons/Total Time</td>
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<td>.007</td>
<td>&lt;.001</td>
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<tr>
<td>MVP Ribbons/Total Time</td>
<td>7.68</td>
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<tr>
<td>Combat Efficiency Ribbons/Total Time</td>
<td>4.40</td>
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<tr>
<td>Accuracy Ribbons/Total Time</td>
<td>12.10</td>
<td>.015</td>
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<td>Melee Ribbons/Total Time</td>
<td>4.06</td>
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<td>&lt;.001</td>
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<tr>
<td>Number of Dog Tags/Total Time</td>
<td>10.20</td>
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<tr>
<td>Points for Capturing Flags/Total Time</td>
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<td>Points for Defending Flags/Total Time</td>
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## Cooperation

<table>
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<th>Category</th>
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<td>Savior Ribbons/Total Time</td>
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<td>Avenger Ribbons/Total Time</td>
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<td>MCOM Attacker Ribbon/Total Time</td>
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<td>MCOM Defend Kills/Total Time</td>
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<tr>
<td>Laser Designation Ribbons/Total Time</td>
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<tr>
<td>Surveillance Ribbons/Total Time</td>
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<td>Resupply Ribbons/Total Time</td>
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<td>Beacon Spawn Ribbons/Total Time</td>
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<td>Resupplies/Total Time</td>
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<td>Heals/Total Time</td>
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<td>Repairs/Total Time</td>
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<tr>
<td>Revives/Total Time</td>
<td>6.14</td>
<td>.009</td>
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</tbody>
</table>
Tactical Choices

<table>
<thead>
<tr>
<th>Category</th>
<th>F</th>
<th>η</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>Transport Warfare Ribbons/ Total Time</td>
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<td>.002</td>
<td>.122</td>
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<tr>
<td>Armored Warfare Ribbons/ Total Time</td>
<td>1.91</td>
<td>.002</td>
<td>.064</td>
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<tr>
<td>Air Warfare Ribbons/ Total Time</td>
<td>1.33</td>
<td>.001</td>
<td>.230</td>
</tr>
<tr>
<td>Number of C4 used/ Total Time</td>
<td>6.63</td>
<td>.006</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Number of mortar shots/ Total Time</td>
<td>1.83</td>
<td>.002</td>
<td>.078</td>
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<tr>
<td>Number of grenades thrown/ Total Time</td>
<td>11.85</td>
<td>.011</td>
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<tr>
<td>Number of claymores used/ Total Time</td>
<td>1.22</td>
<td>.001</td>
<td>.287</td>
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<tr>
<td>Time spent in HMWV/ Total Time</td>
<td>1.68</td>
<td>.002</td>
<td>.109</td>
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<tr>
<td>Time spent in Thunder/ Total Time</td>
<td>1.20</td>
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<td>.298</td>
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<tr>
<td>Time spent in Amtrac/ Total Time</td>
<td>.68</td>
<td>.001</td>
<td>.687</td>
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<tr>
<td>Time spent in vehicles/ Total Time</td>
<td>1.18</td>
<td>.001</td>
<td>.309</td>
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</tbody>
</table>
National Culture vs. Play Style

• According to MANOVA tests
  – National culture has a significant effect on competitive play style
    explaining 5.6% of variance
  – National culture has a significant effect on cooperative play style
    explaining 4.2% of variance
  – National culture has (almost) no effect on tactical choices
5%... Is That All?
Battlefield 4 stats

100,000 records, 158 data fields per record
29 countries with at least 500 players per country
Clustering of average play styles of 29 countries

Significant effects of play style clusters ($p < .05$) of Hofstede dimensions Power Distance, Individualism, Long Term Orientation and Indulgence
Differences between China and US
Nationality and cooperation
The Second "Don't" for Success in Gaming

Don't Play With Americans
The effect of obnoxious behavior on gameplay

Mark Verschoor
Marcus Märtens (TUD)
Arjen Traas
Pieter Spronck
Размеченное поле заполнено информацией о борьбе и коммуникациях между игроками, а также руническими обозначениями. Своим командам игроки сообщают об афк, угрозах и подготовках к встрече. Игровой интерфейс показывает текущую позицию персонажей и ресурсы.
DotA dataset

12,952 matches (Feb 2-6, 2012)

- general game information (date, length, type, winner...)
- player data on all players (name, race, team, total kills, total deaths, gold collected, creep kills...)
- event data (time, type, description...)
- pings (time, player, location...)
- chat messages (time, player, channel, text...)

3,412,488 player-sent messages of which
3,224,532 after 60 seconds of which
62,301 toxic messages

Check for toxicity based on combinations of words with a variety of spellings (Märtens, highly improved by Verschoor, > 99% accuracy)
9,912 players in dataset
15.3% have sent at least 1 toxic message
Relation between toxicity and victory probability

• Remove all games that do not end in victory for one of the teams
• Remove all games which last less than 10 minutes
• Remove all messages which are not in English
• Remove all messages which are sent in an unknown channel

• This leaves 274,456 messages, of which 5,434 are toxic
• We only look at the first toxic message from a game (to get rid of toxic responses), which leaves 565 toxic messages
Modeling victory chances

• Include only game attributes which show a relation between the two teams
• Typical attributes: gold, kills, deaths, assists, APM

• We only include attributes which are available during the game (gold is only known at the end)
• A model at the end of the game which predicts victory has an accuracy > 99% (mainly based on kills and deaths)

• We assume that this model represents player intuition during the game:
  – Prediction: team A wins, team B loses: intuition: A will win
  – Prediction: team A loses, team B wins: intuition: A will lose
  – Prediction: both teams win or both teams lose: intuition: neutral
### 6 situations for first toxic message

<table>
<thead>
<tr>
<th>Group</th>
<th>Toxic team intuition</th>
<th>Toxic team outcome</th>
<th>Number of games</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>win</td>
<td>win</td>
<td>94</td>
</tr>
<tr>
<td>2</td>
<td>loss</td>
<td>loss</td>
<td>171</td>
</tr>
<tr>
<td>3</td>
<td>loss</td>
<td>win</td>
<td>78</td>
</tr>
<tr>
<td>4</td>
<td>win</td>
<td>loss</td>
<td>91</td>
</tr>
<tr>
<td>5</td>
<td>neutral</td>
<td>win</td>
<td>55</td>
</tr>
<tr>
<td>6</td>
<td>neutral</td>
<td>loss</td>
<td>76</td>
</tr>
</tbody>
</table>
6 situations comparison

- win-win
- loss-loss
- loss-win
- win-loss
- neutral-win
- neutral-loss

- toxic
- non-toxic (same outcome)
- non-toxic (same intuition)
Don't Be a Dick
# Increasing datasets

<table>
<thead>
<tr>
<th>Year</th>
<th>Game</th>
<th>Topic</th>
<th>Data items</th>
<th>Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>NWN, Fallout 3</td>
<td>Personality</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>2012</td>
<td>Starcraft II</td>
<td>Skill</td>
<td>100</td>
<td>500</td>
</tr>
<tr>
<td>2013</td>
<td>Battlefield 3</td>
<td>Personality</td>
<td>200</td>
<td>7,000</td>
</tr>
<tr>
<td>2014</td>
<td>Battlefield 3</td>
<td>Age, Personality, Skill</td>
<td>350</td>
<td>13,000</td>
</tr>
<tr>
<td>2015</td>
<td>League of Legends, Word of Warcraft, Battlefield 4 + HL</td>
<td>Age, Personality, Skill, Motivation, Brain type</td>
<td>1,000</td>
<td>5,000</td>
</tr>
<tr>
<td>2016</td>
<td>Battlefield 4</td>
<td>Culture and play style</td>
<td>150</td>
<td>100,000</td>
</tr>
<tr>
<td>2016</td>
<td>DotA</td>
<td>Toxic behavior in chats</td>
<td>20</td>
<td>3,200,000</td>
</tr>
<tr>
<td>2017</td>
<td><em>Destiny, DotA, Steam, mobile games</em></td>
<td>Understanding and predicting player behavior, churn</td>
<td>tens of thousands</td>
<td>millions</td>
</tr>
</tbody>
</table>
THANK YOU MARIO!
YOUR QUEST IS OVER.