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ADAPTING GAME CONTENT WITH A PLAYER TYPOLOGY

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TIIVISTELMÄ

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Pelisisällön mukauttaminen pelaajatypologialla

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Keywords: video games, player types, player typology, game development

Tämä diplomityö tutkii pelaajatypologian käyttöä peliominaisuuksien suunnitteluun ja kehittämiseen. Tätä varten toteutetaan kirjallisuuskatsaus ja kartoitetaan eri pelaajatypologioita, jonka avulla luodaan uusi pelaajatypologia. Tämän typologian perusteella suunnitellaan peliominaisuuksia, jotka lisätään toimintaseikkailupeliin. Pelaajatyyppien ja peliominaisuuksien välinen korrelaatio testataan tapaustutkimuksessa ja tulokset analysoidaan Pearsonin ja Spearmanin korrelaatiokertoimilla.

ABSTRACT

Lappeenranta-Lahti University of Technology LUT
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Mika Savolainen

Adapting game content with a player typology

Master's Thesis

2019

54 pages, 3 figures, 13 tables, 2 appendices

Examiners: D.Sc. (Tech.) Jussi Kasurinen
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Keywords: video games, player types, player typology, game development

This thesis explores the usage of a player typology for designing game features and implementing them to a game. A systematic literature review is conducted to research previously discovered player typologies and based on them a new player typology is created. Game features are designed with this typology and implemented to a single-player action-adventure game used in this study. A correlation between player types and their in-game behavior are tested with a case study and the results are analyzed using Pearson's and Spearman's correlation coefficients.

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Jee.

Hopefully I will someday finish Elemental Echo.

May 2019 in Lahti, Finland

Mika

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LIST OF SYMBOLS AND ABBREVIATIONS

Co-op	Co-operating
DL	Digital Library
EE	Elemental Echo
MMO	Massively Multi-player Online (game)
MMORPG	Massively Multi-player Online Role-Playing Game
NPC	Non-Player Character
SLR	Systematic Literature review

1 INTRODUCTION

Understanding players who play your game is important. This helps making the game more enjoyable. Player typologies has been used to understand game audiences and player behavior. Bartle studied this by asking players "What do they want from Multi-User dungeons" [1]. Since then player types have been explored more and used to understand why they play games. Player types have been linked to different game features [2] but how these features should be implemented could be studied more.

Game development is a challenging field and thousands of games are released every year [3]. An increase in competition has made game development more data driven [4]. With this data, developers can improve the game experience and provide better games.

This master's thesis explores player typologies and how games can improve their engagement by using game features that target different player types. These features are then implemented to a demo version of a game called Elemental Echo (EE). The game is in development and this thesis will provide more data-driven approach for the game development.

1.1 Goals and delimitations

The goal of this thesis is to research discovered player types and analyze what kind of game features are engaging for each player type. This thesis also tries to answer how those features can be created in a single-player action-adventure game. The main research question for this thesis is:

- How should game features for different player types be implemented in a single-player action-adventure game?

This research question can be divided into following sub-questions:

- What kind of player types exist?
- What kind of game features are interesting for these player types?
- How should those features be implemented in a single-player action-adventure game?

The main delimitation for this thesis is the time and resources available for the game development. Developing a game that would target all the player types would be expensive and time consuming. Therefore, only features that are in the scope of this thesis will be implemented to the demo of EE.

Another delimitation for this thesis is not having empirical validation for the developed player typology. Though it should be noted that the developed player typology will be based on other previously discovered player typologies. There is also limited material on how to implement engaging features for player types and therefore these feature implementations will be based on other games and not have any empirical validation.

1.2 Research methodology

This thesis can be separated into three phases. The first phase is formulating the research problem and determining the goal for the research. In this phase the research and literature review processes are planned. This thesis will use systematic literature review (SLR) based on the guidelines by the Kitchenham and Charters [5]. Results of the SLR are then used to create a new player typology.

The second phase is analyzing the player typology and designing game features for each player type. These features will be based on previous studies and other games. The game features are then implemented to a demo of EE.

In the third phase a player typology survey and case study are designed. This case study is used to determinate a correlation between the player types and them interacting with the features intended for them. The players will first answer to a survey that will determinate their player type and then play the demo of EE. Their survey and play data are then analyzed and used to determinate if players engage with the game features designed for them.

1.3 Structure of the thesis

After the introduction the chapter 2 will go over the background material used in this research. The chapter will discuss about what is a player typology, Pearson's correlation coefficient and Spearman's rho.

The chapter 3 presents what is a systematic literature review and how it is conducted for this study. The chapter contains the summaries of the collected materials and the new player typology created for this study.

In the chapter 4 Elemental Echo is presented. The chapter also discusses how features for different player types could be implemented and how these features were implemented to EE.

The chapter 5 presents the survey for analyzing the player type of participants, the case study and the collected data from it. This chapter also discusses about the results of the correlation tests used to the data and what these correlations mean.

The chapter 6 will discuss about the possible risks of this research and what the discovered results mean. This chapter also discusses how this thesis could be improved and what are possible future works.

2 METHODLOGY OVERVIEW

This chapter presents the background material used in this thesis. The first section details what are player typologies and a short history of them. The following sections go over how a correlation analysis is done using Pearson's correlation coefficient and Spearman's rho.

2.1 Player typologies

A player typology is splitting players to different categories based on their motivations for playing a game or actions they do in a game. The oldest typology was offered by Caillois who separated games to four different playful behaviors: Agon, games of challenge and competition; Ale, games of chance; Mimicry, role-player, acting and dress-up and Ilinx, games with visceral impact [6].

Bartle's taxonomy [1] is a well-known player type separation and most player typologies use some or all the player types presented by it. Bartle's taxonomy is based on his research on Multi-User Dungeons and it separates players on a two-dimensional graph. Players can either interact or act with the game world or players. This creates four player types: Achievers, who play for rewards and progression, Explorers, who enjoy exploring the game world, Killers, who enjoy fighting other players and Socializers, who like to interact with other players. Player types and their behavior related to the game can be seen in the figure 1. Bartle later improved this model by adding additional player types: Friend, Griefer, Hacker, Networker, Opportunist, Planner, Politician and Scientist.

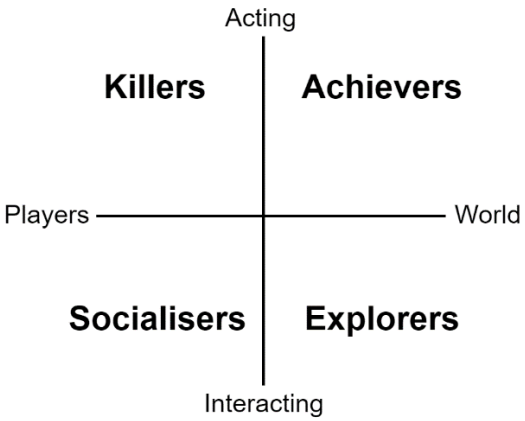

Figure 1. Bartle's player taxonomy [1].

Yee's motivational model [7] was an attempt to improve Bartle's taxonomy. Yee's model is shown in the table 1. Yee's model explored some problems of Bartle's model such as player having only one motivation to play the game.

Table 1. Yee's motivational model [7].

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 Real World, Avoid Real World Problems

Quantic Foundry (company where Nick Yee is a co-founder) later created a new player typology model [8]. This has less focus on the multiplayer games unlike Bartle's and Yee's original models. The player typology model is based on a meta analogy of current player type studies and survey data from over 400000 players. This player typology model is commercial and has limited public access. This model is shown in the table 2.

Table 2. Quantic Foundry's motivation model [8].

Action	**Social**	**Mastery**	**Achievement**	**Immersion**	**Creativity**
Destruction	Competition	Challenge	Completion	Fantasy	Design
Excitement	Community	Strategy	Power	Story	Discovery

2.2 Pearson's correlation coefficient

Pearson's correlation coefficient was first described by Karl Pearson and it measures the linear association between two datasets [9]. The value of coefficient is between -1 and 1 where value -1 means negative correlation, value 1 means positive correlation and value 0 means there is no correlation. Pearson's correlation coefficient can be calculated using formula

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \ \sum_{i=1}^{n}(Y_i - \bar{Y})^2}} \quad (1)$$

[10].

Below are some example calculations:

Example 1.

A:	1	2	3	4	5	6	7	8
B:	2	4	6	8	10	12	14	16

Correlation coefficient between datasets A and B is 1.

Example 2.

C:	1	2	3	4	5	6	7	8
D:	-2	-4	-6	-8	-10	-12	-14	-16

Correlation coefficient between datasets C and D is -1.

Example 3.

E:	1	2	3	4	5	6	7	8
F:	2	-4	6	-8	10	-12	14	-16

Correlation coefficient between datasets E and F is approximately -0.20 meaning there is no significant correlation.

With Microsoft Excel, Pearson's correlation coefficient can be calculated with Excel's Analysis Toolpak [11] and CORREL function [12]. CORREL function takes two datasets as an argument and uses the previously mentioned function to calculate the correlation coefficient.

2.3 Spearman's rho

Spearman's rho or Spearman's rank correlation coefficient is an adapted version of Pearson's correlation coefficient and "It assesses how well an arbitrary monotonic function can describe the relationship between two variables, without making any assumptions about the frequency distribution of the variables." [9]. In simpler terms the Spearman's rho is Pearson's correlation coefficient on the ranks of the data values. While Pearson's correlation compares linear relationship between data sets, Spearman's rho compares monotonic relationship. Spearman's rho can be calculated using formula

$$r_s = 1 - \frac{6\sum_{i=1}^{n} d_i^2}{n^3 - n} \quad (2)$$

[13].

Below are some example calculations:

Example 1.

A:	1	2	3	4	5	6	7	8
Ranks of dataset A:	8	7	6	5	4	3	2	1
B:	2	4	6	8	10	12	14	16
Ranks of dataset B:	8	7	6	5	4	3	2	1

Spearman's rho between datasets A and B is 1.

Example 2.

C:	1	2	3	4	5	6	7	8
Ranks of dataset C:	8	7	6	5	4	3	2	1
D:	16	14	12	10	8	6	4	2
Ranks of dataset D:	1	2	3	4	5	6	7	8

Spearman's rho between datasets C and D is -1.

Example 3.

E:	1	2	3	4	5	6	7	8
Ranks of dataset E:	8	7	6	5	4	3	2	1
F:	16	2	12	3	8	-6	4	13
Ranks of dataset F:	1	7	3	6	4	8	5	2

Spearman's rho between datasets E and F is approximately -0.12.

When there is a tie between values, their rank is a sum of rank values divided by the number of ranks. For example:

G:	1	2	3	4	5	6	7	8
Ranks of dataset G:	8	7	6	5	4	3	2	1
H:	2	4	6	10	10	12	14	16
Ranks of dataset H:	8	7	6	4.5	4.5	3	2	1

Spearman's rho between datasets E and F is approximately -0.99.

With Microsoft Excel, Spearman's rho can be calculated by first using RANK.AVG function. RANK.AVG determinates the rank of a data value and it takes two arguments: a data value and a dataset of the data value. Spearman's rho can be then calculated by using the CORREL function on the rank datasets [14].

3 LITERATURE REVIEW ON PLAYER TYPOLOGIES

This chapter explores how players are separated with different typologies and what motivations they have for playing games. This chapter also presents the systematic literature review done for this study and tries to answer following questions:

- What player types exist for playing games?
- What kind of game features are interesting for these player types?

3.1 How to conduct a systematic literature review

Literature collecting for this thesis will be done with a SLR based on the guidelines of Kitchenham and Charters [5]. The SLR differs from a standard review as it tries to provide subjective results and avoid for example researcher bias when conducting the research. The SLR can be separated to three different main steps: Planning the Review, Conducting the Review and Reporting the Review. A full process for the SLR is presented below. The stages might appear in sequence, but it is important to iterate between the steps [5].

1. Planning the review
    i. Identification of the need for a review.
    ii. Commissioning a review.
    iii. Specifying the research question(s).
    iv. Developing a review protocol.
    v. Evaluating the review protocol.
2. Conducting the review
    i. Identification of research.
    ii. Selection of primary studies.
    iii. Study quality assessment.
    iv. Data extraction and monitoring.
    v. Data synthesis.
3. Reporting the review
    i. Specifying dissemination mechanisms.
    ii. Formatting the main report.
    iii. Evaluating the reporting.

3.1.1 Planning the SLR

The first step for planning the SLR is to determinate the need for it. This can be either finding material for a research or doing it as a research by itself. There should be a goal when planning to do the research whether it is to create an overview of a research area or try to answer a specific question. The second step is commissioning the review, but it is not necessary for this thesis and is generally relevant to commercial researches.

The third step is to specify the research questions. Based on the goals of the research, there should be specific research questions to better understand them. The research questions are the most important part of the research and the results of the SLR should answer to these questions.

The fourth step is developing a review protocol. A protocol is important to keep the research subjective and reduce the researcher bias. Without a protocol it is possible to only select results that support researchers' views. A protocol also provides clear results where also material is collected, and search process can be analyzed. Other researchers can preview the review protocol and conclude that the results of a review are not accurate because the process for collecting material is flawed. A protocol should determine the strategy used for the search of primary studies and resources, the study selection criteria, the study selection procedures, the quality assessment and the data extraction strategy.

The fifth step is evaluating the review protocol. The review protocol should be evaluated by more experienced person. In the case of a master's thesis it should be done by a supervisor. The reviewer will confirm that the search strings are accurate and the data extracted and the data analysis procedure will address and answer to the research questions.

3.1.2 Conducting the SLR

The first step for conducting the SLR is the identification of the research. The systematic process differs a systematic review from a standard review. It is necessary to determine and follow a search strategy and this should be discussed with a supervisor. When creating a search strategy there are some iterative methods to improve the process for example doing

preliminary searches targeted at previous systematic reviews, doing trial searches with different search strings, compering trials searches to previous researches and consulting with experts on the field. This is also the part where digital libraries are chosen and the reasons for selecting libraries should be specified. The key part of conducting the SLR is documenting the search to be as transparent as possible.

The second step of conducting the SLR is a selection of primary studies. Once relevant material has been collected, they should be sorted based on the relevance to the research. There should be predeterminated study selection criteria for including and excluding the materials. These criteria should be based on the research questions. Exclusion criteria are usually related practical issues for example language barriers, access to research and the date of publication.

The third step is a study quality assessment. Together with inclusion/exclusion criteria the quality of studies should also be analyzed. This will provide more detailed inclusion/exclusion criteria, provide differences between different quality studies, weigh the importance of individual studies with different results, help guide with interpretations of findings and a recommendation for further research.

The fourth step is a data extraction and monitoring. The data extraction is collecting data from the collected studies. All the information that answer the review questions and study quality criteria are important. In addition to answers to questions, the data collection should contain a date of the data extraction and the information of the papers like title, authors, journal and publication details.

The final step of conducting the SLR is the data synthesis. It involves collating and summarizing the results of included studies. These descriptions can be descriptive and highlight the differences and similarities between study outcomes. The data should be presented in tabular form including sample size, estimates, difference between values and units used for measuring the effect.

3.1.3 Reporting the SLR

Reporting the SLR is writing up the results of the review. The first step of reporting the SLR is specifying the dissemination strategy. It is important to report results effectively. Therefore, it is usually recommended that the planning the dissemination strategy is done together with systematic review protocol. The dissemination can mean sharing results with academic journals and/or conferences, but it can also mean sharing it with other interested parties such as practitioner-oriented media or Web pages.

The second step of the SLR is formatting the main systematic review report. Usually the SLR will be part of a technical report or a section of a thesis. In addition to this, it can also be in a journal or conference paper. In this case, this SLR will be just part of a section of a thesis.

The final step is evaluating the SLR report. Supervisors usually review reports as part of the examination process as it will be done for this thesis.

3.2 A systematic literature review on player typologies

This subsection will go over how the SLR was conducted in a search of player typologies. The results of the literature review are at the end of this subsection.

3.2.1 Planning the SLR on player typologies

As discussed previously, the SLR starts with identification the need for a review. In this case, the need to do the literature review is to help to complete the main study. The goal of this literature review is to discover different player types and what motivates them to keep playing.

Research questions for the SLR are:

1. What types of players play single-player games?
2. What kind of content these players are interested in?

A review protocol will be based on the chapter 3.1.2. The search will start by doing trial searches with keywords from [2]. The results of the trial searches will be used to refine the

keywords. After a relevant number of results the papers will be excluded based on inclusion/exclusion criteria, at first by title, then by keywords, abstract and finally by screening the papers. The process is summarized in the figure 2.

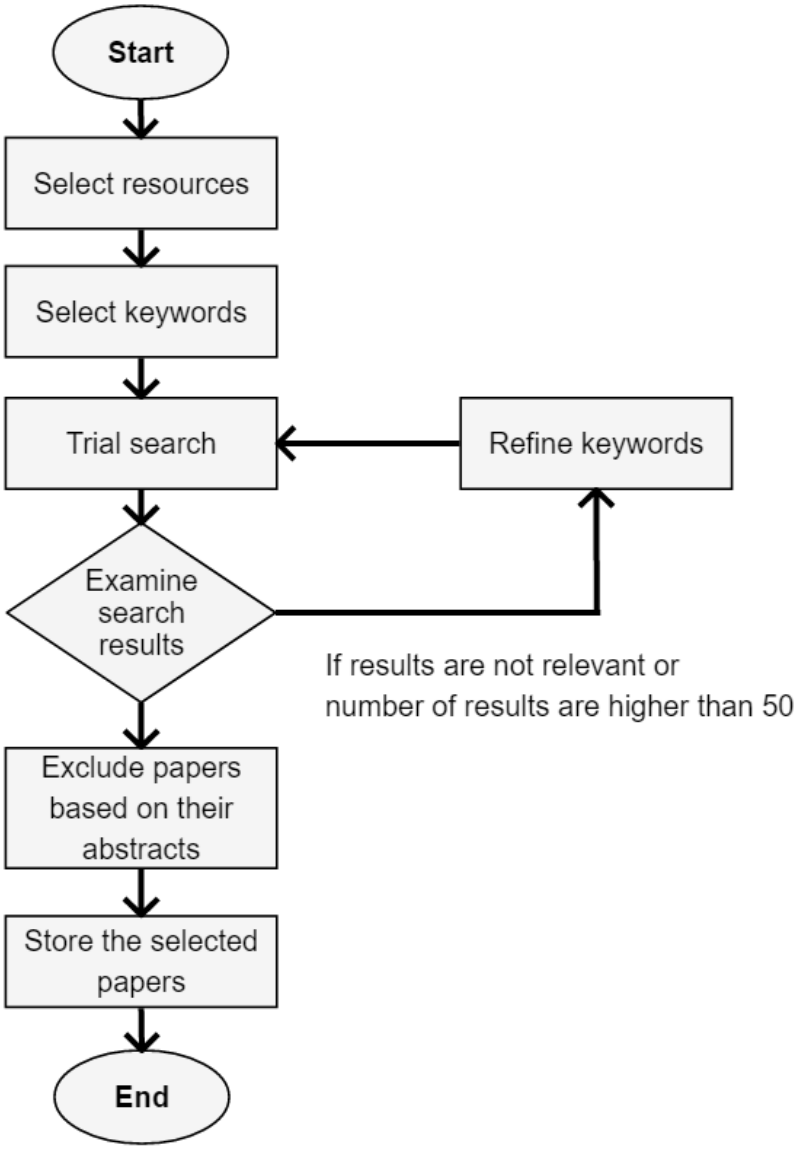

Figure 2. Search process [adapted from [15]]

The exclusion and inclusion criteria are based on [2]. The inclusion criteria promote papers relevant to the research. Inclusion criteria 2. is adapted as the number of search results is higher than previously and therefore the number of selected papers would also be too high for this scope of research. The exclusion criteria remove papers not relevant for the research and papers that are not available for the author. The criteria are following:

Inclusion

- Any article where a player type model or player characterization framework is presented.
- Any article, where a player type model or characterization framework has been applied to implement features targeting these player types.
- Any article that presents different player motivations in video games.

Exclusion

- The full text of article is unavailable.
- The text is not written in English or Finnish.
- The text is written before 2000.
- Articles where the scope is not video games.
- Duplicate of previously selected research paper.
- Chapter of a book will not be included, only full articles.

A review protocol is evaluated by the supervisor and he will give feedback on the review protocol and determinate whether the process should be changed. The review protocol is important to reduce researcher bias, because without the protocol it is possible for researcher to select only studies that support the claim.

3.2.2 Conducting the SLR on player typologies

Conducting the research will start with trial searches. Selected databases (Digra Digital Library (DL), ACM Digital Library, IEEE Xplore and ScienceDirect) are based on the previous study [2]. Web of Science and complimentary searches with Google and Google Scholar will not be done because as previous study discovered the number of results is too high for this scale of research. The search results will be trimmed until the number of results is small enough. The search will start with a “player type” keyword. A search result distribution using different keywords are in the table 3. Searches from databases provided 2322 papers. The search results with keywords “player type” and “player types” from ScienceDirect and ACM were duplicates based on scanning the results and by excluding duplicate results the number of search results is 1340.

Table 3. The search results from databases using different keywords.

	Digra DL	ACM DL	IEEE Xplore	ScienceDirect	Total
Player type	1	37	7	945	990
Player types	3	37	20	945	1005
Player motivation	7	27	17	248	299
Player typology	3	9	0	16	28
Total	14	110 (73)	44	2154 (1209)	2322(1340)

The search results were first trimmed based on a title then an abstract and then scanning the text. The papers were included or excluded using the previously mentioned inclusion and exclusion criteria. The database search order was Digra DL, ACM DL, IEEE Explore and ScienceDirect. The keyword search order was “Player type”, “Player types”, “Player motivation” and “Player typology”. “Player typology” keyword was discovered during thw SLR and it was selected as a keyword because multiple selected papers had that keyword. The search results with “Player type”,” Player types” and “Player motivation” keywords from ScienceDirect were excluded from this research and only the papers discovered using “Player typology” keyword were selected. ScienceDirect was the last on the search order and the number of search results were too high. The keywords could have been refined to provide less search results but keeping the keyword consistent with databases felt like a better option**.** The total number of selected papers were 22 and a distribution between databases and keywords is shown in the table 4.

Table 4. The selected results from databases with different keywords.

	Digra DL	ACM DL	IEEE Xplore	ScienceDirect	Total
Player type	1	5	1	0	7
Player types	1	0	3	0	4
Player motivation	1	3	0	0	4
Player typology	1	3	0	3	7
Total	4	11	4	3	22

Some articles were excluded even though they specified player models or motivations in games, but they were so specific to their game that it would not been useful. For example, a study by Tong et al. [16] had a survey about why players played Pokémon Go and the results were “To collect all Pokémons”. This article could be adapted to be more useful as the same answer could be translated to “to complete all achievements” but studies like that were excluded because of the additional amount of work to do when deconstructing the papers.

Some articles were excluded because their scope was not video games. There was researcher’s bias when choosing what counted as a video game and what as a gamified app. Generally, games that had clear game-like mechanics were included but games with only statistics and achievements were excluded.

3.2.3 Reporting the SLR on player typologies

All selected papers and their summaries are listed in the chapter 3.4. The SLR provided multiple different player types and motivations. MMO (Massively Multi-player Online) and multiplayer games are still a popular target for player type studies. The single-player game studies discovered in this SLR are small scale researches which explains the higher number of single-player game related researches. Understating the player types of educational games will help to increase players’ playtime and learn more. Multiple studies seem to be more generic and not focusing on a specific game type. A separation between categories is shown in the table 5.

Table 5. Focus of the player typologies in the papers.

MMO or multiplayer	Single player	Educational game	Generic
5	7	3	7

Discovered player typologies have clear similarities but also differences. It is hard to put all player types to a one player typology model. [17] tried to do this by combining psychological perspective to find similarities between player type models. Behavioral sliders similar to [18] might be the best approach to starting to deconstruct all the player types. This kind of approach could create a very large number of specific player types and that kind of a separation could be done by collecting data from players during a gameplay.

The search results were much higher compared to the previous research (45 to 1312) [2]. The biggest rise in numbers of articles were in ScienceDirect from 15 to 1209. This made the SLR require more work than expected and some databases like Web of Science had to be excluded from this research.

The game adaptation for specific player types is also explored in multiple studies [19], [20], [21], [22] but these seem to have had mixed results. Studies by Staewen et al. [19] and Dias & Martinho [20] had improved results with player enjoyment by using game adaptation. The studies also discussed about how hard is to determinate player types before playing a game. [21] also mentioned that some players might be multiple types at the same time so locking game features to target specific player types might not be the best approach.

3.3 Overview of articles acquired

This subsection lists summaries from all the selected articles. All the articles are also presented in the table 7 at the end of this chapter.

[7] analyzes different motivations to play MMORPGs (Massively Multi-player Online Role-Playing Game). This study surveyed 3200 people that completed 39-point survey. Participants answered questions about their motivations and why do they play. The survey results provided multiple different answers that allow dividing people into categories shown in the table 1. The study showed that it is hard to divide people into specific categories and a different gameplay motivation does not remove other motivations.

[23] present RA-model for mobile MMORPG based on Bartle's study. This article separates players to three categories: Socializers, who communicate with others and work in teams. Fighters, who prefer to work alone and only work with others if they need something. Moderators, who are a mix of these types. The study was done to ZhanGuo mobile MMORPG where player types were defined based on their achievement / relationship ratio. In the future, this model could be applied to other mobile MMORPG to verify its validity.

[21] presents an educational game called "S.C.R.U.B". The study separates players to three different player types: Achievers, Explorers and Winners and has special game features for

each of them. Explorers are intrinsically motivated to play the game and the special features for them are bonus trivia and explore mode. Achievers are performance-approach motivated and they want to earn high scores and do challenging tasks. The special features for them are timer where players get bonus points for extra time and a leaderboard. Winners are focused on performance-avoidance and try to avoid losing. The special features for them are a tutorial and an option to show answers to trivia questions. The players first answered to a survey and based on the survey the game adds special features designed for them.

[24] analyzes player motivations from psychological perspective and compares how these motivations have been used in Witcher. The study separates motives to five categories: Power has a need to be in charge and noticed. Materialistic needs to associate with inanimate objects. Affiliation needs relationships with others. Achievement has a need to overcome obstacles. Informational needs to gather and analyze information. Sensual has a need for gratifying experiences that satisfy senses. The study concluded that multiple of these desires could be implemented with relationships and interaction with NPCs (Non-player characters).

[25] collected data from players playing Tomb Raider: Underworld. Based on their actions in game, players were divided into four categories: Veterans, who solved the game quickly with few deaths, Pacifists, who mainly died to enemies, Solvers, who are average overall but used few help requests on puzzles and Runners, who completed the game semi quick but requested help often.

[20] presents how a game can provide adaptive content for the player. This study uses demographic game design that splits players to four categories, Conquerors, who enjoy being in control and competition. Managers, who enjoy planning strategies and tries to master the game. Wanderers, who like to play for fun and explore the game. They enjoy stories and emotional links. Participants, who enjoy playing as part of a group and only play games in a social context. Using these typologies developer implemented features targeting specific player types such as less punishing death for Wanderers and Participants. The study tested players in a game called Grim Business. Participants first answered to a survey that determinate their Myers-Briggs type and then they played modified version of the game. The game collected data from the play session and after playing the users filled a survey

answering questions about their preferences and experience in the game. There were two test groups. The first group played game adapted for their player type and the second group played the game adapted for another player type. The first group rated game enjoyment much higher and felt that game was more immersive. The test groups were 20-35 large and representatives from all player types.

[26] separates players based on how they act within the rules of the games. This is just a model with no empirical evidence. There are four player types: Regulative players, who follow the rules, Constitutive players, who exploit the game world provided for them, Deregulative players, play by not respecting certain rules for example by hacking. Deconstitutive players, break social rules by trolling.

[27] presents a four-way play style division based on psychology and analysis on previous player typology studies. The players are separated into four categories: Logistical players, who like to optimize, behave with caution and are tolerant to rules. Tactical players, who like to improvise and behave with impulsiveness and are tolerant to risks and speed. Strategic players, who like solving puzzles and thinking ahead, behave with logic and are tolerant to complexity. Diplomatic players, who enjoy co-operation and behave with empathy. These types were tested using a survey. The survey asked about player emotions in different situations and had 1040 responders. The traits that could be more explored are openness, preference for anger, tolerance for real-time play, preference for group vs solo-play and persistence and obsessive play.

[28] separates player types using personality studies. In this study they present four player types: Conqueror, who enjoys challenge, is patient with frustration and prefers to finish games. Manager, who likes tactical challenge**.** They want to earn the winning and likes to master the game. Wanderer, who likes to explore the game and is mostly looking for fun. They will easily stop playing if they get bored. Participant, who likes to play for the story and social experience. They like to see what the story has to offer.

[29] summarizes multiple studies and compares differences between player types in them. By creating a concept-centric list the study compered how different studies separate player types using Achievement, Exploration, Sociability, Killer, Immersion and In-game demographics. The study states that game designers should use player types as a design tool but not as a limiting factor.

[17] summarizes multiple other studies (Bartle, Yee, Caillois, Fullerton, Laws, DGD1, Fritz, BrainHex) and splits them into categories based on their personality, interest in game mechanics and what game mechanics are relevant to them. The players are separated into five player types: Dominant is interested in conflict and challenge and they prefer to be in control. Objectivist is interested in rewards and prefer to play by themselves. Humanist enjoys playing with others and want to help them. Inquisitive enjoys exploration and new things. They prefer discovery over following commands. Creative enjoys crafting and developing things using experimentation. They like to have a guide but enjoys not following it. This study is just theory crafting and has not empirical evidence. The study links game features to player types and suggests what content might be interesting for them.

[6] presents BrainHex player typology model where players are separated into seven categories: Seekers look to gain enjoyment from games by a sense of wonder. Survivors enjoy games with thrill and fear. Daredevils enjoy games with taking risks and challenges. Masterminds enjoy solving puzzles and creating strategies. Conquerors enjoy beating other players and challenges where they have low odds. Socializers enjoy games as a form of making connections and spending time with others. Achievers enjoy games as progress bars and collecting rewards.

[30] presents a gamified learning system called Reflex. This study is based on a gamification model created by Marczewski and it separates players into eight categories based on whether they prefer acting or interacting and with users or the system. Players are separated based on their motives and whether they act with intrinsically motivated or extrinsic motivated. Intrinsically motivated types are Philanthropist (purpose), Achiever (mastery), Socializer (relatedness), Free spirit (autonomy). Extrinsically motivated are Self-seeker (purpose), Consumer (mastery), Networker (relatedness), Explorer (autonomy).

[19] analyzes player motivations and behaviors based on the rewards and actions in the game. This study separated player personality characteristic to eight categories: Competition, Challenge, Enjoyment, Social interaction, Diversion, Fantasy interests, Arousal/Excitement and Entertainment. In the study, players played a 2D platformer developed for this study. They also answered surveys before, during and after playing the game. Based on the study, the players played differently based on their play motives for example players who play for distraction preferred to use short term rewards.

[18] separates players' motivation by creating 250 behavior cards that were based on a Fallout: New Vegas mod. Discussing with experts they separated player actions into seven behavior sliders presented in table 6. These categories can be better used for a grammar understanding player behavior. Using these categories, specific player behavior types can be targeted.

Table 6. Behavior sliders from [18].

Strategic action <-> Impulsivity	Does a player behave with impulsion or strategy?
Acquisition	Player's need to collect items.
Approach <-> Avoid	Does a player prefer to avoid or approach something for example a quest or an enemy?
Explorative attitude	Does a player like to explore for example the world or dialog choices?
Compliance <-> Independent activity	Does a player follow a command given by NPCs?
Social warmth <-> Rudeness	Is a player rude or polite?
Morality <-> "Renegade behavior"	Does a player act with morality?

[31] present a Trojan player typology model. This model splits players into six categories: Socializers, who enjoy the social aspects of the game. Completionists, who like to master every aspect of the game and try everything in the game. Competitors, who play mainly to win and like to play in the highest level of play. Escapists play just to avoid real world and allow them to pretend to be someone else in the game. Story-driven players, who like to

learn about the story of the game and want to be part of the game's story. Smarty-pants, who play games to make them smarter and try to improve their intellectual skills. This study was done to two games: League of Legends and Chevalier's Romance Online 3.

[22] explores users' behavior in a survival game using BrainHex model [6]. They implemented special features targeted towards player types and tested whether the players would engage with their targeted activities. The study had 31 participants and they filled a survey that determinated their player type before playing the survival game prototype. Based on the study, the researchers did not find a clear correlation between player types and doing the activities designed for them.

[32] separates player motives using Bartle's taxonomy and implements game features to their game Mad Science to target these player types using Zhang's ten design principles. For example, by giving players freedom to choose what activity they want to do, the game supports autonomy and provides engaging content for explorers. This study was not tested with participants and there are no clear answers do these features answer to the needs of the players.

[33] separated player types to different categories based on the curiosity models. There are four curiosity models: Social, Sensory/Cognitive, Explorative and Novelty-seeking. The study got 932 valid responses and they were asked about their in-game preferences and their BrainHex type. The survey results were compered to their Grimoire score inside Destiny and the survey could correctly predict player preference activities.

[34] explored player motives using Motive Disposition Theory that analyzes player motives using explicit and implicit methods. At first players answered to a survey that has questions about their personality, motives and BrainHex player type. After the survey the players played a game of Minecraft with two random other participants and their goal was to build a house. The participants could only communicate with chat logs. The chat logs were analyzed whether their actions correlated with questionnaire. The goal of the study was to show that implicit motives can help to understand player behavior. The player motivations were separated into four categories: Achievement, Affiliation, Power and Autonomy. The

study concludes that explicit motives explain what choices players make, but implicit motives explain what bring players pleasure.

[35] is based on Mumford's learning theory and separated players into four categories: Competitors, who enjoy action and competition. They rely on intuition and find actions and strong competition to be the best way to improve themselves. Dreamers, who enjoy playing roles and fantasy world avatars. They prefer social interactions, diplomacy and negotiation. Logicians, who enjoy logic and analyses when playing a game. They learn the rules of the game and apply them when exploring the game world. Strategists, who enjoy complex problems and want to solve them in the most efficient way. These players prefer thinking in a long term by creating hypothesis and try to create practical ways to do the game tasks.

[36] analyzes player motivations using a survey and a brain scanning technique called Electroencephalographic. By using earlier studies and Electroencephalographic, the player motivations are separated into three categories: Achievement motivated players prefer moderate challenging tasks and regular feedback. They also prefer to work alone and take calculated risks. Affiliation motivated players prefer goals with a high probability of success and a low risk to avoid conflict and competition. They want to belong into a group and enjoy a collaboration over competition. Power motivated players take high risks that gives them control over others. They like to win and want status and recognition. The goal of this study is to create a game in the future that identify the player motivation by gameplay metrics and EEG indicators.

Table 7. List of all the selected articles.

	Year	Author	Article name	Player typologies or motives
[7]	2005	Yee	Motivations of Play in MMORPGs	Achievement, Social and Immersion
[23]	2007	Fangvi et al.	RA-model: a taxonomy model of player activities in mobile MMORPGs	Socializers, Moderators and Fighters
[21]	2008	Margerko et al.	Intelligent adaptation of digital game-based learning	Achievers, Explorers and Winners
[24]	2009	Bostan	Player motivations: A psychological perspective	Materialistic, Affiliation, Achievements, Informational and Sensual
[25]	2009	Drachen et al.	Player Modeling using Self-Organization in Tomb Raider: Underworld	Veterans, Solvers, Pacifists and Runners
[20]	2011	Dias & Martinho	Adapting content presentation and control to player personality in videogames	Conqueror, Manager, Wanderer and Participant
[26]	2011	Mosca	Just a Cyberplace The rules in videogames: between Ontology and Epistemology	Regulative, Constitutive, Deregulative and Deconstitutive
[27]	2011	Bateman et al.	Player Typology in Theory and Practice	Logistical, Tactical, Strategic and Diplomatic
[28]	2012	McMahon et al.	Personality and player types in Fallout New Vegas	Conqueror, Manager, Wanderer and Participant
[29]	2012	Tuunanen & Hamari	Meta-synthesis of player typologies	Gaming intensity and skill, Achievement, Exploration, Sociability, Killer, Immersion and In-game demographics
[17]	2013	Ferro et al.	Towards personalised, gamified systems: an investigation into game design, personality and player typologies	Dominant, Objectivist, Humanist, Inquisitive and creative
[6]	2013	Lennart et al.	BrainHex: A neurobiological gamer typology survey	Achiever, Conqueror, Daredevil, Mastermind, Seeker, Socializer and Survivor

Table 7. Continued

[30]	2014	Herbert et al.	An Investigation of Gamification Typologies for Enhancing Learner Motivation	Exploiter, Networker, Consumer, Self-Seeker, Free Spirit, Socializer, Achiever and Philanthropist
[19]	2014	Staewen et al.	Player characteristics and their relationship to goals and rewards in video games	Competition, Challenge, Enjoyment, Social interaction, Diversion, Fantasy interests, Arousal/Excitement and Entertainment
[18]	2014	Kabakov et al.	A bottom-up method for developing a trait-based model of player behavior	See Table 6
[31]	2015	Khan et al.	The Trojan Player Typology: A cross-genre, cross-cultural, behaviorally validated scale of video game play motivations	Socializers, Completionists, Competitors, Escapists, Story-driven and Smarty-pants
[22]	2016	Rogers et al.	Towards Player-Centric Adaptivity: Interactions of Gameplay Behaviour and Player Traits in a Survival Game	Achiever, Conqueror, Daredevil, Mastermind, Seeker, Socializer and Survivor
[32]	2017	Harteveld & Sutherland	Personalized Gaming for Motivating Social and Behavioral Science Participation	Achiever, Killer, Explorer and Socializer
[33]	2017	Schaekermann et al.	Curiously Motivated: Profiling Curiosity with Self-Reports and Behaviour Metrics in the Game "Destiny"	Social, Sensory/Cognitive, Explorative and Novelty-seeking
[34]	2018	Poeller et al.	Let Me Be Implicit: Using Motive Disposition Theory to Predict and Explain Behaviour in Digital Games	Achievement, Affiliation, Power and Autonomy
[35]	2018	Bontchev et al.	Playing styles based on experiential learning theory	Competitor, Logician, Strategist and Dreamer
[36]	2018	Liu et al.	Toward Electroencephalographic Profiling of Player Motivation: A Survey	Achievement, Affiliation and Power

3.4 Created player typology model

A player typology model should be chosen before designing game features for the specific player types. Even though Bartle's [1] and Yee's [7] works are an important part of the player typology history, their focus on multiplayer games limits them from looking at a wider range of player types [6]. On the other hand, BrainHex [6] does not include all players such as role-players and the difference between Conquerors and Daredevils is too small in the context of single-player games.

Quantic Foundry's motivation model [8] could be useful, but as it is commercial player type model, it has limited resources publicly available for free. This player typology presents most player types from other discovered studies, but there are some player types missing for example Survivor, player that enjoys horror games. Although, this could be interpreted as a part of Excitement motivation.

The created player typology is a combination of BrainHex [6] and Quantic Foundry's motivation model [8]. One specific player typology model did not seem to cover all the areas or differences between some player types seemed too small. Although this player type model is close to Quantic Foundry's motivation model, it has some differences specifically on the larger categories. This model separates players into four main motivations and other smaller motivations as depicted in the table 8. The player typology is made in focus with EE, but it can also be used with different games. A short description of each player type is shown in the table 9.

Table 8. Created Player Type Model.

Social	**Challenge**	**Freedom**	**Immersion**
Teamwork	Mechanical	Exploration	Roleplay
Competition	Mental	Destroyer	Escapism
	Progress	Creator	
	Discomfort		

Players can do the same actions for different motivations for example players can explore the game world because they seek rewards, or they can explore it for the sake of exploration. It is important to note that the players are not only one player type and can belong to multiple types at the same time [7].

Table 9. The summary of all player types

Player type	**Description**	**Similar player types**
Teamwork	Enjoys social contact in games. Prefers working together with other players.	Social: Community, Socializer, Yee's Social
Competition	Enjoys playing versus other players.	Social: Competition, Competition, Competitors
Mechanical	Plays for the challenge. Wants to complete the game but might stop if it gets too dull or easy.	Mastery: Challenge, Achievement: Power, Daredevil
Mental	Plays for the challenge. Prefers game where they can take their time. Likes puzzles or large strategies.	Mastery: Strategy, Smarty-pants, Masterming
Progress	Plays for progression. Wants to collect all the achievements and collectables.	Achievement: Completion, Achiever, Advancement
Discomfort	Plays for discomfort. Enjoys games that make them feel uncomfortable.	Action: Excitement, Survivor
Explorer	Plays for the fun. Likes to find hidden things, seeks stories and mysteries.	Creativity: Discovery, Explorer, Discovery
Destroyer	Plays for no specific goal and might not finish the game. Enjoys destroying the game world and not following rules.	Action: Destruction, Killer, Constitutive player
Creator	Plays for fun. Enjoys creating and crafting things for fun.	Creativity: discovery, design, Creative
Role-player	Plays for fun. Plays as is part of the game world. Likes to interact with everything and follows the story.	Immersion: Fantasy, Role-Playing, Immersion, Wanderers
Escapism	Enjoys games as relaxing and comforting way to spend time. Uses games as a way to immerse them away from the real world.	Yee's Escapism, Troijan Escapists

Social-motivated players enjoy multiplayer games. They are less interested in what type of games they are playing. These players want to either play with or against other players. Teamwork-motivated players want to work together and are ready to sacrifice their progress for others. These players enjoy interacting in in-game communities and working in a team. Competition-motivated players enjoy fighting other players. The games for Social-motivated players are online games such as World of Warcraft and Overwatch. These players often enjoy playing with friends either by playing with or versus them.

Challenge-motivated players enjoy games that challenge them. Mechanical-motivated players play games that challenge their mechanical skills and reaction time. The games for them are for example Super Meat Boy. Mental-motivated players play games that make them think and allow them to take time. The games for them are for example Civilization or Candy Crush. Discomfort-motivated players play games that make them feel uncomfortable. The most popular emotion they enjoy is fear and the games for them are Horror games for example Amnesia: The Dark Descent. A challenge for these players is that they can overcome a discomfort created by a game. Unlike other player typology models, in this typology model Progress-motivation (Achievement in other models) is part of Challenge-motivation category because progress is about patient and energy to spend time to play the game. Many games might have achievements that are not challenging but require a huge time sink or must endure a nulling task. The main enjoyment for Progress-motivated players is finishing collections and all the achievements in games.

Freedom-motivated players play games that allow them to make choices. Exploration-motivated players like to explore the game world and try to find hidden areas. Destroyer-motivated players enjoy breaking the rules of the game. They do not follow the rules of a game even though it might stop them from progressing the game. Examples of this behavior would be attacking helpful NPCs. Creator-motivated players enjoy crafting and creating things for fun. They also enjoy spending time customizing their in-game characters, houses or towns.

Immersion-motivated players enjoy just playing a game and they do not have any other clear motive to play. They can easily get demotivated if there are stopping challenges. Roleplay-

motivated players play the game like they would be a part of the game world. They let the story to guide them and prefer not to spend much time thinking the possible outcomes or optimizations for the game. Escapism-motivated players enjoy games as a time sink. They do not have specific goals for playing the game and often play the same game as they do not have energy to start a new game where they would have to learn new systems. They use games to immerse them away from the real world.

4 DESIGNING GAME FEATURES WITH PLAYER TYPOLOGY

This chapter first presents the game Elemental Echo used in this thesis. Then it goes over what kind of features each player type would be interested in and how these features could be implemented in the game.

4.1 Elemental echo

Elemental Echo is a single-player action-adventure game. In the game the player explores the game world, fights enemies, talks with NPCs and collects items that help him in the journey. The game is in-development and this thesis will be used as a guide how specific features should be added to the game to provide engaging content for different types of players.

Figure 3. A screenshot from Elemental Echo.

4.2 Selecting player types represented in Elemental Echo

This subsection discusses what player types from the created player typology will be represented in the demo of Elemental Echo. The player typology explores all the possible player types, but in the scale of this thesis, the game cannot target all the player types like other higher budget games like World of Warcraft.

Social-motivated players will not have any targeted features in EE. They want player interaction and it is hard to provide in this scale. Single-player games can provide some player interaction with Social Media integration like Superbrothers: Sword & Sworcery EP. Single-player games can also later change to local co-op (Co-operating) games like Hyper Light Drifter and Stardew Valley. These games started as a single-player and later added a co-op. Single-player games can provide leaderboards for Competition-motivated players where these players can share their progress and compete with others.

From Challenge-motivated players, Mechanical- and Progress-motivated players will have targeted features. Mechanical- motivated players can be entertained with high speed action and fast reaction times and for these players EE can provide challenging enemy encounters. Progress-motivated players enjoy collectables and getting the game 100% (completing everything) and for these players EE can provide collectable items. Mental-motivated players enjoy complex puzzles or long-term strategies which are hard to provide in EE as the game is more action-focused. Action games can provide puzzles to provide small rewards and reduce the repetition of the gameplay. For example, BioShock uses small puzzles that allow saving in-game currency before buying items. In action-focused games these puzzles should not be mandatory as not all players enjoy them. Discomfort- motivated players are not targeted in EE as these players usually play games that are purely targeted for them. Creating uncomfortable atmosphere can be unpleasant for those who do not enjoy that. Non-horror games can provide some small moments of discomfort for changing the pace of the gameplay. For example, Hat in Time is a standard non-horror game, but one of its stages has elements from horror games such as a dark theme and hiding from a monster.

From Freedom-motivated players, Exploration and Destroyer- motivated players will have targeted features in EE. Exploration-motivated players enjoy exploring the game world to

see what is has to offer. For these players EE offers hidden areas outside the main gameplay area where players are not meant to go. Destroyer-motivated players enjoy breaking the norms of the game world. Simply allowing the death of NPCs would not be interesting therefore attacking the NPCs should provide some kind reaction. The game should not stop because of death of NPCs though it can be made more difficult and not reward that kind of behavior. For example, in the Grand Theft Auto attacking random NPC will cause the police to chase the player making the gameplay more challenging until the player hides long enough or gets arrested. For these players EE allows attacking friendly NPCs and becoming hostile to them. Creator-motivated players enjoy crafting and expressing themselves by creating items and customizing their characters. In this scale, this cannot be provided in EE, but the game could allow character customization in the future.

Immersion-motivated players enjoy becoming part of the game world and playing the game as a relaxing experience. For Roleplay-motivated players EE allows them to be part of the game world and interact with NPCs. EE will not target Escapism-motivated players as the version of the game is just a demo and will not provide long enough game experience.

In the table 10 is a summary of all the features mentioned before and possible future implementations that could be used later to target more wider audience.

Table 10. A summary of features to implement for each player type.

Player type	**The features implemented**	**Future possibilities**
Mechanical	Hard enemies	More challenging enemies
Progress	Collectables	Achievements
Explorer	Hidden areas	More hidden areas
Destroyer	Allow killing friendly NPCs	Allow joining hostile faction
Role-player	Interaction with NPCs	More dialog choices
Teamwork	None	Social media integration, local co-op
Competition	None	Leaderboards
Mental	None	Puzzles
Discomfort	None	Darker themed areas
Creator	None	Customization of character
Escapism	None	Longer gameplay

4.3 How game features are implemented to Elemental Echo

This subsection will discuss how previously mentioned features are implemented to EE. These features will be tested and analyzed whether our implementations of these features are accurate, and do they engage the correct player types. In this demo of EE, the goal for the players is to find five villagers and then return to the town.

EE should give enough freedom for Destroyer-motivated players to break the norms of the game. This will happen by allowing them to attack friendly NPCs which will cause the NPC to attack the player character. EE will allow attacking and killing friendly NPCs what causes them to attack the player. In EE the player can also kill a barkeeper character that will allow the player to go straight to the goal.

EE should provide enough things to do for the Progress-motivated players. EE will provide collectables as a form of discoverable NPCs. The game will track the number of found NPCs allowing the player to see how many NPCs he has found. Additional things to do are breaking all destroyable objects and killing the enemies.

Exploration-motivated players enjoy searching hidden areas. EE will make it clear that there are areas to explore by allowing the player to go any direction they want from the start. EE has also a secret area near the starting point. These secret areas are hidden in the small gaps between trees. These secret areas also offer healing items that provide combat advantage. Exploration-motivated players usually are not that interested in a challenge and this makes the game easier for them as they get more collectables than regular players.

Mechanical-motivated players enjoy high speed action and EE will provide this with a non-mandatory boss fight. Defeating the boss will require rotating around him and striking at the right moments. The boss fight is not mandatory, so it does not frustrate players who are not interested in a challenging combat. EE will have a checkpoint near the boss so the player can quickly re-enter the fight.

5 PLAYER TYPES AND IN-GAME BEHAVIOR - CASE STUDY

This chapter at first goes over the case study where the player types and their actions in EE were tested. After this the next sections details the collected data from the case study and uses Pearson's and Spearman's correlation coefficients to determinate the validity of the data.

5.1 Introduction to the case study

The effects of an engagement from implemented game features were tested with a case study. The case study consisted of three stages: player typology survey, play session and after-play survey. Before the players played EE demo, they took a survey where they answered to questions that would determinate their player type. Player typology survey was created with Google Docs and the questions of the survey are presented in the Appendix 1. The survey was based on the BrainHex survey [6] and Quantic Foundry's player motivation survey [8]. Answerers would choose an option from Love it, Like It, It's okay, I dislike it, or I hate it. There was no demographical data collection as the main goal was to see correlations between player types and play-behavior. After the players answered to the questionnaire, they played the demo of EE. The demo collected data from following events:

- Time played
- Damage done
- Damage done to villagers
- Villagers killed
- Objects destroyed
- Villagers found
- Enemies killed
- Mushrooms destroyed
- Areas Explored
- Walked path (Transition between areas)
- Did the test time run out (Time player over 15 minutes)
- Bread collected
- Player deaths
- Player deaths to the boss
- Player deaths to the NPCs
- Bar keeper killed (Premature game ending event)
- Villagers talked to

This data will be used to determinate their behavior and do they interact with the features targeted to them. After the gameplay, the players would answer another survey presented in the Appendix 2. The survey has questions about how the players felt about the game and its features. They answered to this survey from 1-5 on a scale Totally disagree and Totally agree.

Twelve volunteers took part on the presented case study. It was together with GameChangers [37] Beta Program participants in the GameChangers office. The participants were doing the test in groups of three and each of them were given a test ID that allowed combining the data from each phase of the test. They were guided to take the player type survey first and then EE demo was enabled for them. EE would collect data on participants and save it to a text file. After playing the game, the participants were guided to do the after-play survey. The game data was not saved from one play session so the test data from one volunteer had to be discarded making overall collected data to eleven.

The test times were between 5-20 minutes. EE had a max time of 15 min to prevent the test from taking too long. The goal of the game was to get to the tavern which could be achieved by either killing the barkeeper or by finding five villagers. In hindsight, the game should have had an option to keep playing after winning the game as some of the participants accidentally won the game before even realizing the game was over.

5.2 Hypothesis for the case study

This subsection details the expected outcomes for the case study. The players whose player types matches the features implemented should have a higher enjoyment of the game. The behaviors done in EE demo should correlate with the answers from the survey. For example, an Exploration-motivated player should search the game world more than other player types. Table 11 lists all the expected correlations players should have based on their player type and in-game behavior.

Table 11. The expected correlations between player types and in-game actions.

Player type	**Expected correlations**
Destroyer	Damage done to villagers, Villagers killed, Objects destroyed and Mushrooms destroyed
Progress	Villagers found, Bread collected, Mushrooms destroyed and Objects destroyed
Role-player	Villagers talked to
Skill	Player deaths to the boss and Enemies killed
Explorer	Time played, Areas Explored and Villagers found

5.3 Case study results

The data analysis was first done with Pearson's correlation coeffient using Microsoft Excel [12] as described in the chapter 2.2. The data values with absolute value larger than 0.6 were noted to have some correlation and are listed to table 12. Pearson's correlation coeffient recommends using dataset size minimum of 30 [12] which can affect the accuracy of these results.

The results from Pearson's correlation coefficient were retested using Spearman's rho. All the results with two-tailed p-value less than 0.01 were ignored and assumed not to have enough significant difference. The selected correlations are listed in the table 13.

As the case study group was small, it is hard to say whether the results are because of a random change or because of the behavior of the player type. The knowledge about being tested, limited time to take the test and a player typology survey might have affected their playstyle.

Based on the correlation values, the players who enjoy planning strategies were more likely to talk to the friendly NPCs and killed less of them. This was probably because the NPCs gave clues where a hidden NPC was and these players were trying to solve where he was hidden. Killing NPCs would prevent them from talking to them again. These players knew

that they could do damage to NPCs as nobody had damage done to NPCs equal to 0. There was also a correlation between players who enjoy collecting a huge collection and them not attacking villagers. It was probably for the same reason as previously mentioned as these players were trying to find the last missing villager.

Table 12. The results from Pearson's correlation test.

Player typology question	**Correlation with the gameplay**	**Correlation with after-play survey**
Q1	Damage done (-0.62) Objects destroyed (-0.64)	Q27 (0.77)
Q2	Damage done (-0.66) Areas explored (-0.72) Villagers found (-0.73) Enemies killed (-0.77)	
Q4	Player deaths to NPC (-0.67)	Q27 (0.64)
Q7	Areas explored (-0.64)	
Q8	Player deaths to NPC (-0.67)	Q29. (0.64) Q31 (0.71)
Q9	Villagers talked to (0.78) Damage done to villagers (-0.80) Villager killed (-0.84)	
Q10	Villager killed (-0.84) Damage done to villagers (-0.87)	
Q11	Damage done to villagers (-0.76) Villager killed (-0.78)	Q31 (0.71)
Q12	Bread collected (0.78)	Q29 (0.66) Q31 (0.66)
Q13	Player deaths to NPC (0.59)	Q27 (-0.78) Q30 (-0.81)
Q14	Damage done to villagers (0.63)	
Q15	Time played (0.83) Damage done (0.69) Villagers found (0.68) Enemies killed (0.67) Bread collected (0.76)	
Q16	Time played (0.63) Enemies killed (0.62) Villager talked to (0.59)	Q26 (0.59)
Q19	Player deaths to NPC (-0.71)	
Q20		Q26 (0.69) Q29 (0.63)
Q24	Damage done to villagers (-0.60) Villager killed (-0.67)	Q29 (0.66) Q26 (0.62)

Table 13. The results from Spearman's rank correlation.

Combination explored	**Spearman's Rho**	**Two tailed p**
Q9 & Villager killed	-0.83054	0.00155
Q9 & Villagers talked to	0.78933	0.00387
Q12& Bread collected	0.78293	0.00438
Q15 & Time played	0.77460	0.00512
Q1 & Q27	0.77049	0.00552
Q24 & Villager killed	-0.75414	0.00733
Q10 & Damage done to villagers	-0.73968	0.00927
Q15 & Bread collected	0.73557	0.00988

There was a correlation between players' answers to "Games that make them uncomfortable" and the number of breads collected. This could be just based on a random chance as there should not be a clear correlation between these actions, but players can feel that collected bread acts as a safety for them and therefore Discomfort-motivated players tried to collect more of them.

There was a correlation between players' answers to "Exploring what I can find." and the playtime and the number of collected breads. This was an expected outcome as the players who enjoy exploring would enjoy more searching the area and therefore taking more time finishing the game. The players who also like to explore are more likely to find more items which explains the higher number of breads.

There was a correlation between players' answers to "Using games as a way to avoid real-life problems." and the number of friendly NPCs killed. This was probably because Escapism-motivated players did not want to make the game any harder and wanted to enjoy the test experience.

There was an interesting positive correlation between the players who enjoy playing with other players and them enjoying interacting with NPCs. It could be possible that these players would feel that interacting with NPCs was the best part of the game because they enjoyed interaction with human-like units.

6 DISCUSSION AND CONCLUSION

The collected data has some correlation between the player types and their gameplay actions. An issue with this study is that the target test group was too small to create any clear relevant results. A recommended minimum dataset size for Pearson's correlation coefficient is 30 [12]. The cross examination using Spearman's rho was used to trim less relevant results, but both tests would have benefited from a bigger test group. It is also important to note that even if tests show a correlation, it does not always mean a causation. Some of the player actions might have been because this was a testing environment and the players behaved less-like how they would normally play in their home.

As the case study had a small group size, it is possible that only a small demographic group was part of the test. There was no demographic data collection as part of the study as the participants had limited time to answer to the questions and the focus should be more on getting an accurate player typology.

Based on the results, many of the players did not engage on the content that was planned for them. Some participants answered that they enjoy causing mayhem but did not attack friendly NPCs meaning that attacking them might not been engaging enough. This could also be because of these players baited the enemies to attack friendly NPCs instead of killing them by themselves. EE demo did not track this data.

Exploration-motivated players behaved somewhat expectedly by spending a lot of time in the game, but they did not explore any more area. This could be because of not wanting to spend too much time in the game or because the hidden areas were too hard to find.

There was no correlation between Progress-motivated player and their play-behavior. This could be because of a test environment and the knowledge about not having a permanence in their collection. Because of this, these players might have been less motivated to search all the items.

The collected data will be used to improve Elemental Echo but this study could be improved in the future. A Player typology survey could be improved and more test subjects could

provide more accurate data. A game data collection could be done online as it puts less pressure for the player.

7 SUMMARY

The goal of this thesis was to explore how game features targeting different player types could be implemented in a single-player game. At first, this thesis goes over what is a player typology and different correlation analysis methods used in it. In the next chapter, the thesis presents how the background material was collected using the systematic literature review. With this background material a new player typology model was created. Game features for each player type was predicted based on background material and other games. These features were then implemented to the demo of Elemental Echo. With the demo of the game a case study was created where a correlation between player type and play-behavior was analyzed. In the case study, participants first answered to a player typology survey and then played the demo of EE. After playing the game they took an after-play survey.

The data collected from the case study was then analyzed with Pearson's and Spearman's correlation coefficients and based on results there was some correlation between play-behavior and player types. For example, Exploration-motivated players found more items and spent more time in the game. Some of the features did not work as intended for example there was no correlation between Destroyer-motivated players and fighting friendly NPCs. With these results, possible future studies were suggested and the ways how EE could be improved in the future.

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APPENDIX 1. PLAYER TYPOLOGY SURVEY QUESTIONS

ID	**Question**	**Player type reference**
Q1	"Playing with other players."	Teamwork, Competition
Q2	"Co-operating with strangers."	Teamwork
Q3	"Being part of an in-game community, group or guild."	Teamwork
Q4	"Playing versus other players."	Competition
Q5	"Defeating player opponents."	Competition
Q6	"Executing a complex combo attack."	Mechanical
Q7	"High speed action."	Mechanical
Q8	"Solving a challenging puzzle."	Mental
Q9	"Planning a strategy."	Mental
Q10	"Completing a huge collection."	Progress
Q11	"Getting 100% (completing everything in the game)."	Progress
Q12	"Playing games that make me feel uncomfortable."	Discomfort
Q13	"Feeling scared, terrified or disturbed."	Discomfort
Q14	"Doing something that was not intended."	Exploration, Destroyer
Q15	"Exploring what I can find."	Exploration
Q16	"Wondering what is behind a locked door."	Exploration
Q17	"Overpowering other players and non-player characters."	Destroyer
Q18	"Causing mayhem."	Destroyer
Q19	"Building a great looking city or house."	Creator
Q20	"Spending time into customizing my characters, cities and spaceships."	Creator
Q21	"Being part of the game world."	Roleplay
Q22	"Interacting with non-player characters."	Roleplay
Q23	"Playing the same game for multiple years."	Escapism
Q24	"Using games as a way to avoid real life problems."	Escapism

APPENDIX 2. AFTER-PLAY SURVEY QUESTIONS

ID	Question
Q25	The game was fun.
Q26	The game was hard.
Q27	Interacting with the non-player characters was fun.
Q28	The enemies were challenging.
Q29	Exploring hidden areas was fun.
Q30	There were enough things to do.
Q31	I always had a clear goal.