The Application of Design Principles on Fast-Action Puzzle Games

A study on how the use of design principles affect how players perform in Fast-Action Puzzle Games
Abstract

This thesis studies a few established design principles which were implemented in a developed fast-action puzzle game prototype. The aim was to study how several design principles affected the performance of players.

The prototype was described as a Time-Based Memory Mashup with six different “presets” based on the established design principles in which small changes occur.

All participants in the study played through all six presets. Gameplay data was gathered from the participating users and were automatically recorded into a database in order to determine which preset was the most successful.

Participants also filled in a survey to answer questions regarding on how they would judge their own performance, engagement and enjoyment of each played preset.

Collected gameplay data from the participants were compared and ranked to determine which presets and design principles were the most effective. Surveys, observations and interviews have been studied to see if it matched the statistical data.

Participants had higher performances with a fixed or more forgiving timer, which participants preferred the most. Downgraded graphics and sound were enjoyed the least, however did not lead to much worse performances. An increased difficulty had the most effect in lowering performances.

Design principles such as Pacing, Difficulty, Feedback, Interface Design and Foreground had the most potential to lower performances among participants.

Keywords:
Game Design, Design Principles, Fast-Action Puzzle Game, Player Engagement, Player Performance, Evaluation
Table of Contents

1 Introduction 9
  1.1 Aim ................................................................. 10
  1.2 Limitations ....................................................... 10
  1.3 Problem ........................................................... 11
  1.4 Research Questions ............................................. 11
  1.5 Hypothesis ....................................................... 12

2 Research 13
  2.1 Literature Review .................................................. 13
  2.2 Defining Fast-Action Puzzle ...................................... 14
  2.3 Game Design & Fundamentals of Game Design ..................... 15
  2.4 Flow Theory, Evolution & Creativity: or, 'Fun & Games' ......... 17
  2.5 Understanding game design for affective learning ............... 18

3 Translating Game Design 20
  3.1 Default Gameplay Mechanics ...................................... 20
  3.2 Changes in the Second Iteration .................................. 21
  3.3 Preset 1: Default ................................................ 23
  3.4 Preset 2: Easier .................................................. 24
  3.5 Preset 3: Harder .................................................. 24
  3.6 Preset 4: Choices ................................................ 25
  3.7 Preset 5: Static Time .............................................. 26
  3.8 Preset 6: Audiovisual ............................................. 27

4 Methodology 28
  4.1 Target Group ..................................................... 28
  4.2 Description of the Developed Game ................................ 28
  4.3 Data Collection Method ............................................ 29
  4.4 Surveys Method .................................................... 31
  4.5 Observations Method .............................................. 32
  4.6 Interviews Method ................................................ 32
  4.7 Second Iteration and Goal ........................................ 33

5 Results 34
  5.1 Results of Iteration 1 .............................................. 35
    5.1.1 A Quick Summary ............................................. 38
    5.1.2 Surveys .......................................................... 38
    5.1.3 Interviews .................................................... 40
  5.2 Results of Iteration 2 .............................................. 41
    5.2.1 A Quick Summary ............................................. 46
    5.2.2 Surveys .......................................................... 47
    5.2.3 Interview ...................................................... 47
    5.2.4 Differences ................................................... 48
  5.3 Effect of Design Principles ....................................... 48
  5.4 Ranking Presets & Design Principles ............................. 50

6 Discussion 51
6.1 Game Duration .............................................. 51
6.2 Making Mistakes .......................................... 51
6.3 Surveys, Observations & Interviews .................. 52
6.4 Making Choices ............................................ 53
6.5 User Performances ........................................ 53
6.6 Flow Theory ................................................ 54
6.7 Skipping Cards ............................................. 54

7 Conclusions .................................................. 55
  7.1 Guidelines .................................................. 56
  7.2 Reflecting Upon Design Principles .................... 57
  7.3 Background of Participants ............................. 58
  7.4 Improvements in the Second Iteration ............... 59
  7.5 Improvements & Future Study ......................... 59

References .................................................... 61

A Ranked Results (Highest Values) ......................... 63
  A.1 Iteration 1 ............................................... 63
  A.2 Iteration 2 ............................................... 64

B Raw Data (Sorted) ........................................... 67
  B.1 Iteration 1 ............................................... 67
  B.2 Iteration 2 ............................................... 69

C Raw Data (Per Participant) ................................. 73
  C.1 Iteration 1 ............................................... 73
  C.2 Iteration 2 ............................................... 78

D Surveys ....................................................... 81
  D.1 Iteration 1 ............................................... 81
    D.1.1 Survey #1 ........................................... 81
    D.1.2 Survey #2 ........................................... 81
    D.1.3 Survey #3 ........................................... 82
    D.1.4 Survey #4 ........................................... 83
    D.1.5 Survey #5 ........................................... 83
    D.1.6 Survey #6 ........................................... 84
    D.1.7 Survey #7 ........................................... 84
    D.1.8 Survey #8 ........................................... 85
    D.1.9 Survey #9 ........................................... 85
    D.1.10 Survey #10 .......................................... 86
    D.1.11 Survey #11 .......................................... 86
    D.1.12 Survey #12 .......................................... 87
  D.2 Iteration 2 ............................................... 89
    D.2.1 Survey #1 ........................................... 89
    D.2.2 Survey #2 ........................................... 90
    D.2.3 Survey #3 ........................................... 92
    D.2.4 Survey #4 ........................................... 94
    D.2.5 Survey #5 ........................................... 95
    D.2.6 Survey #6 ........................................... 97
    D.2.7 Survey #7 ........................................... 99
List of Figures

1  Flow Theory chart exemplified by Chou (2018) .................. 17
2  Instructions for participating with the experiment ................ 19
3  Instructions are given for each preset during the experiment .... 20
4  Prototype of the experiment, which shows the game in action .... 22
5  Instructions are given for each preset during the experiment .... 23
6  Setting a rating for a preset once it had been played through .... 23
7  Prototype of the experiment, which shows the game in action .... 29
8  The login system that was connected with a database .......... 30
9  Setting a rating for a preset once it had been played through .... 30
10 Example of the survey ............................................. 31

Results of Iteration 1 .................................................. 35
11 Highest Rating as an average ..................................... 35
12 Highest Points as an average ..................................... 35
13 Highest Correct, Incorrect & Ratio (correct divided by incorrect) of Swapped Card Sets as an average ................ 36
14 Highest Correct, Incorrect & Ratio (correct divided by incorrect) of Swapped Card Sets if each presets lasted as long as Default .................. 36
15 Highest Played Time and Highest Remaining Time on the Timer as an average ........................ 37
16 Highest Time Played in seconds as an average ................. 37
17 Presets which were the most and least enjoyed during the survey .... 39
18 Issues presented during the survey ................................ 39
19 Summary of agreed opinions from the three interviews ....... 40

Results of Iteration 2 .................................................. 41
20 Highest Rating as an average ..................................... 41
21 Highest Obtained Total Points and Obtained Card Values as an average ........................ 41
22 Highest Obtained Total Points and Obtained Card Values if each presets lasted as long as Default .................. 42
23 Highest Amount of Used and Maximum Skips as an average .................. 42
24 Highest Obtained Level and Level Increases as an average .... 43
25 Highest Used Game Pauses as an average ..................... 43
26 Highest Correct, Failed & Ratio (correct divided by incorrect) of Swapped Card Sets as an average ................ 44
27 Highest Correct, Failed & Ratio (correct divided by incorrect) of Swapped Card Sets if each presets lasted as long as Default .................. 44
28 Highest Time Played and Highest Timer as an average ......... 45
29 Highest Time Played in seconds as an average ................. 45

Background of Participants .......................................... 58
30 Age Group of Participants ........................................ 58
31 Gender of Participants .............................................. 58
List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Used Databases</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>Participants (2019) - Iteration 1</td>
<td>34</td>
</tr>
<tr>
<td>3</td>
<td>Participants (2019) - Iteration 2</td>
<td>34</td>
</tr>
<tr>
<td>4</td>
<td>Ranked Results (Highest Values) - Iteration 1</td>
<td>63</td>
</tr>
<tr>
<td>5</td>
<td>Star Rating</td>
<td>63</td>
</tr>
<tr>
<td>6</td>
<td>Total Points</td>
<td>63</td>
</tr>
<tr>
<td>7</td>
<td>Correct Swapped Card Sets</td>
<td>63</td>
</tr>
<tr>
<td>8</td>
<td>Incorrect Swapped Card Sets</td>
<td>63</td>
</tr>
<tr>
<td>9</td>
<td>Ratio Correct / Incorrect Swaps</td>
<td>63</td>
</tr>
<tr>
<td>10</td>
<td>Difficulty Increases</td>
<td>63</td>
</tr>
<tr>
<td>11</td>
<td>Time Left Clock</td>
<td>63</td>
</tr>
<tr>
<td>12</td>
<td>Time Played</td>
<td>63</td>
</tr>
<tr>
<td>13</td>
<td>Used Skips</td>
<td>64</td>
</tr>
<tr>
<td>14</td>
<td>Obtained Card Face Value</td>
<td>64</td>
</tr>
<tr>
<td>15</td>
<td>Maximum Available Skips</td>
<td>64</td>
</tr>
<tr>
<td>16</td>
<td>Times Pausing Game</td>
<td>64</td>
</tr>
<tr>
<td>17</td>
<td>Maximal Used All Skips</td>
<td>64</td>
</tr>
<tr>
<td>18</td>
<td>Total Points</td>
<td>64</td>
</tr>
<tr>
<td>19</td>
<td>Correct Swapped Card Sets</td>
<td>64</td>
</tr>
<tr>
<td>20</td>
<td>Incorrect Swapped Card Sets</td>
<td>65</td>
</tr>
<tr>
<td>21</td>
<td>Ratio Correct / Failed Swaps</td>
<td>65</td>
</tr>
<tr>
<td>22</td>
<td>Reached Level</td>
<td>65</td>
</tr>
<tr>
<td>23</td>
<td>Time Left Short Clock</td>
<td>65</td>
</tr>
<tr>
<td>24</td>
<td>Time Left 2-Minute Clock</td>
<td>65</td>
</tr>
<tr>
<td>25</td>
<td>Fields Cleared With Cards</td>
<td>65</td>
</tr>
<tr>
<td>26</td>
<td>Highest Played Time</td>
<td>66</td>
</tr>
<tr>
<td>27</td>
<td>Raw Data (Sorted) - Iteration 1</td>
<td>67</td>
</tr>
<tr>
<td>28</td>
<td>Highest Star Rating</td>
<td>67</td>
</tr>
<tr>
<td>29</td>
<td>Highest Total Points</td>
<td>67</td>
</tr>
<tr>
<td>30</td>
<td>Highest Correct Swapped Card Sets</td>
<td>67</td>
</tr>
<tr>
<td>31</td>
<td>Highest Incorrect Swapped Card Sets</td>
<td>67</td>
</tr>
<tr>
<td>32</td>
<td>Highest Ratio Between Correct And Incorrect Swapped Card Sets</td>
<td>68</td>
</tr>
<tr>
<td>33</td>
<td>Highest Reached Difficulty</td>
<td>68</td>
</tr>
<tr>
<td>34</td>
<td>Highest Amount Time Left On Clock</td>
<td>68</td>
</tr>
<tr>
<td>35</td>
<td>Highest Amount Played Time</td>
<td>68</td>
</tr>
<tr>
<td>36</td>
<td>Raw Data (Sorted) - Iteration 2</td>
<td>69</td>
</tr>
<tr>
<td>37</td>
<td>Highest Star Rating</td>
<td>69</td>
</tr>
<tr>
<td>38</td>
<td>Highest Total Points</td>
<td>69</td>
</tr>
<tr>
<td>39</td>
<td>Highest Obtained Card Face for Points</td>
<td>69</td>
</tr>
<tr>
<td>40</td>
<td>Highest Used Skips</td>
<td>69</td>
</tr>
<tr>
<td>41</td>
<td>Highest Maximal Available Skips</td>
<td>69</td>
</tr>
<tr>
<td>42</td>
<td>Highest Maximal Used All Skips</td>
<td>70</td>
</tr>
<tr>
<td>43</td>
<td>Highest Correct Swapped Card Sets</td>
<td>70</td>
</tr>
<tr>
<td>44</td>
<td>Highest Incorrect Swapped Card Sets</td>
<td>70</td>
</tr>
<tr>
<td>45</td>
<td>Highest Ratio Between Correct And Incorrect Swapped Card Sets</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Highest Fields Cleared With Cards</td>
<td>70</td>
</tr>
<tr>
<td>45</td>
<td>Highest Reached Level</td>
<td>71</td>
</tr>
<tr>
<td>46</td>
<td>Highest Level Increases</td>
<td>71</td>
</tr>
<tr>
<td>47</td>
<td>Highest Times Pausing Game</td>
<td>71</td>
</tr>
<tr>
<td>48</td>
<td>Highest Amount Time Left On Short Clock</td>
<td>71</td>
</tr>
<tr>
<td>49</td>
<td>Highest Amount Time Left On 2-Minute Clock</td>
<td>71</td>
</tr>
<tr>
<td>50</td>
<td>Highest Amount Played Time</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td><strong>Raw Data (Per Participant) - Iteration 1</strong></td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>Participant 01</td>
<td>73</td>
</tr>
<tr>
<td>52</td>
<td>Participant 02</td>
<td>73</td>
</tr>
<tr>
<td>53</td>
<td>Participant 03</td>
<td>73</td>
</tr>
<tr>
<td>54</td>
<td>Participant 04</td>
<td>74</td>
</tr>
<tr>
<td>55</td>
<td>Participant 05</td>
<td>74</td>
</tr>
<tr>
<td>56</td>
<td>Participant 06</td>
<td>74</td>
</tr>
<tr>
<td>57</td>
<td>Participant 07</td>
<td>74</td>
</tr>
<tr>
<td>58</td>
<td>Participant 08</td>
<td>75</td>
</tr>
<tr>
<td>59</td>
<td>Participant 09</td>
<td>75</td>
</tr>
<tr>
<td>60</td>
<td>Participant 10</td>
<td>75</td>
</tr>
<tr>
<td>61</td>
<td>Participant 11</td>
<td>75</td>
</tr>
<tr>
<td>62</td>
<td>Participant 12</td>
<td>76</td>
</tr>
<tr>
<td>63</td>
<td>Participant 13</td>
<td>76</td>
</tr>
<tr>
<td>64</td>
<td>Participant 14</td>
<td>76</td>
</tr>
<tr>
<td>65</td>
<td>Participant 15</td>
<td>76</td>
</tr>
<tr>
<td>66</td>
<td>Participant 16</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td><strong>Raw Data (Per Participant) - Iteration 2</strong></td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>Participant 01</td>
<td>78</td>
</tr>
<tr>
<td>68</td>
<td>Participant 02</td>
<td>78</td>
</tr>
<tr>
<td>69</td>
<td>Participant 03</td>
<td>78</td>
</tr>
<tr>
<td>70</td>
<td>Participant 04</td>
<td>79</td>
</tr>
<tr>
<td>71</td>
<td>Participant 05</td>
<td>79</td>
</tr>
<tr>
<td>72</td>
<td>Participant 06</td>
<td>79</td>
</tr>
<tr>
<td>73</td>
<td>Participant 07</td>
<td>79</td>
</tr>
<tr>
<td>74</td>
<td>Participant 08</td>
<td>79</td>
</tr>
<tr>
<td>75</td>
<td>Participant 09</td>
<td>80</td>
</tr>
<tr>
<td>76</td>
<td>Participant 10</td>
<td>80</td>
</tr>
</tbody>
</table>
1 Introduction

In this thesis the fast-action puzzle genre have been studied. Fast-action puzzle games is a specific type within the puzzle genre where limitations are enforced such as time limits and fail conditions. Solving fast-action puzzle games might improve problem-solving abilities where the results of improving on that particular ability can act as a motivator to become even better (Hsu 2018). Tetris is a well known fast-action puzzle game that uses mechanics such as losing conditions and a sense of urgency and remains popular even after 30 years thanks to it’s addictive design (Griffiths 2014, Sheffield 2014).

A game’s core consists of four basic elements: mechanics, story, aesthetics and technology. Mechanics define the rules and goals of the game. The story is what moves players with emotion. Not every story needs to be told directly as even the audiovisual presentation can serve as a story that plays out on the background. Aesthetics are what players will remember about a game. Aesthetics define how a video game is looked at, is heard, is felt, is remembered and is experienced. Technology is what brings a game to existence. How easily these elements can be incorporated into a game depends on it’s overall structure (Shell 2008). These elements may define how well players are able to excel at a specific game. In this thesis the mechanics and aesthetics from design principles were studied. In specific how it affects the performance of users playing fast-action puzzle games.

Design principles can be recognized as the direction of the game, behavior of events, storytelling, mechanics, presentation of sound and visuals, pacing, player interaction, environment layout, player definition player responses to other characters and mechanics and the appeal of the game to the player (Gamasutra 2009). A game can apply multiple design principles at once. The application of user interaction can turn an interactive media product into a game (Adams 2010). A concept that is used in the design of games is the Flow Theory by Csikszentmihalyi (1990). A study conducted by Sweetser (2017) demonstrates that the Flow Theory can be applied on several game design mechanics. This includes for example task completion, the ability to concentrate on a task, the balance between challenge and skill, sense of control, immediate feedback and immersion into the game.

Video games are defined by their rules which are imposed upon through the application of design principles (Adams 2010). Every game has rules, even something as simple as an interface can be seen as a rule which allows the player to be informed and receive feedback. Rules change how players experience, interact with, perceive and enjoy a game. Removing a vital display of information might lead to the player making uninformed decisions and as a result could prevent the player from wanting to continue playing it.

The design of a game could always be improved upon through iteration. Just because a game has been finished and released would not necessarily mean it is perfected. Robert Byrne once wrote that “Good judgment comes from experience, which comes from poor judgment” (Byrne 1986). The design of a game can only be fully improved upon through iteration, failure and learning from others (O’Connor 2013). Iteration is a vital part of improving upon game design. Existing and proved systems can be reshaped into new mechanics. Only through testing and iteration can be seen if these reshaped mechanics improve a game’s design (Luton 2009).
By encouraging the discussion of certain values set for each included design principle, this thesis considers how game developers could apply and implement these particular principles in their own game design. By ranking several design principles developers could get a better understanding of their importance towards engaging game design. The thesis will discuss the methods to measure performance so that design principles can be ranked to determine how these principles affect the performance of players in a game.

1.1 Aim

The application of design principles on games within the fast-action puzzle genre led to different results among the performance of players. This thesis discusses how several design principles affected the performance of players that interacted with a fast-action puzzle game prototype. The results would benefit other games in the same genre as well. A summary of what could be the most and least effective applications of several studied design principles according to the results of this study would clarify how to prioritize the design of fast-action puzzle games for an improved performance and engagement of users.

Several tested game design principles were compared against each other in order to indicate their importance, where some design principles could prove to be more effective than others. This study could make developers more aware of the effect which design principles can have for fast-action puzzle games. The tested game design principles in this study were ranked through having participants performing within a game prototype and having them to rate it, answer how they perceived it and study their performance of it.

1.2 Limitations

A prototype game in the fast-action puzzle genre was designed to let participants interact with it, where their performance with the prototype was measured and studied. Participation could be remotely at distance. Player statistics and surveys were automatically reported to the researcher by email in text and were automatically recorded into a database once a participant concluded participation. There was a larger focus to study the gameplay statistics and surveys from the participants since recording the data using both these methods could be automatized and did not require the immediate presence of the researcher. The Observation and Interview methods were manually conducted by the researcher and could not be automated. Both methods were therefore used on a small number of participants.

Not all design principles which were studied in this thesis were tested due to the limited scope of time and resources. Certain design principles could not be realized into the prototype and would require an extended framework.

The survey did not support a background study of the participating users from the first iteration. Due to time constraints development of the prototype and survey had been simultaneously concluded and shipped for deployment in order to proceed with the study of gathering results.

The target group for participants of the first iteration was aimed towards students (age 18-30) because it was the most accessible option for this study. Participation was opened to everyone in order to avoid a too limited amount of participants. A small amount of participants did not fill in the survey, but did participate with the prototype and were therefore included in the study.
Participants who tampered with the prototype through altering the code in runtime were discovered and were therefore removed from the study. It was a technical limitation that could be abused by replacing the code in runtime, which required a certain skill in programming and was therefore highly unlikely that less technical experienced participants abused it. Tampering with the prototype caused unattainable or unexpected results which were incomplete in the database, which led to the identification of invalid participants.

After the study was concluded a second study was commenced which intended to solve several issues. This second iteration had its own set of participants. A few limitations were solved for the second iteration, in specific limitations that were constrained by time and resources. There have been fewer participants the second time because the second research was conducted during the summer, which likely led that most potential participants were on holiday. Issues which cheating had been resolved and the prototype’s design was altered to behave more like an fast-action puzzle game. Due to unresolved issues with the hosting server, all PHP and MySQL code was removed, leaving only the HTML and JavaScript code. This caused participation with the survey to be mandatory, unlike in the first alteration where data could still be obtained without participation in the survey.

1.3 Problem

Players which are not performing well within a fast-action puzzle game could not enjoy it. An awareness of the application of design principles would hopefully lead to a better understanding on how improve the performance for players of fast-action puzzle games. This could also give a better understanding which design principles would require prioritization of development resources and which ones do not. This thesis studies several existing and established design principles from literature which were applied on a fast-action puzzle prototype to study how these design principles affect the performance of players.

Multiple design principles that have different applications have been tested in order to see which effect they had on the performance of players. The tests included for example measuring how the amount of played time or difficulty affected their performance. The tested presets were compared to study how certain design principles affected the performance and perceivance of the participants. In this study, this lead to an understanding of which applications of the design principles affected the performance of participants of the fast-action puzzle prototype. Improving the design of a fast-action puzzle game could result in better performances for players which could continue them to play more.

1.4 Research Questions

This section phrases the research questions which were studied in this thesis. The research questions refer to terminology which are described and defined as the following:

- The use of "players" in this section refers to players that participated in this study with the fast-action puzzle game prototype that was researched in this study.

- The use of "design principles" in this section refers to the design principles which were studied and tested in this study.

- The use of "prototype" in this section refers to the developed fast-action puzzle game prototype that was researched in this study.
The questions which were researched in this study:

- Which applications of the *design principles* affected the performance of the *players*? (Section 5.3)
- Which applications of the *design principles* led to better or worse performances of the *players*? (Sections 6.2 and 6.5)
- Which presets of the *prototype* led to different results in the performance of the *players*? What are the differences in the results? (Sections 5.1 and 5.2)
- How would the *design principles* be ranked in number to indicate their importance in design? (Sections 5.4 and 7.2)
- How were the applications of the *design principles* perceived by the *players*? (Sections 6.1, 6.3, 6.6 and 7.1)

1.5  Hypothesis

Design principles that rely on the *Flow Theory* are expected to have a large effect. Interruptions or waiting too long on things to happen affect the flow for players and lead to them getting annoyed, which is a negative result (Adams 2010). Changes in a game’s design could affect how much attention the player puts into the game and how much it would absorb the player into the game.

Design principles for difficulty, time and choices to make gameplay decisions are expected to make the largest differences in how the player will perceive a game or how they perform.

- Having a fixed time and easier gameplay causes better performances.
- Harder gameplay causes worse performances.
- Removing choices for players to make gameplay decisions, sound, graphics and animation causes worse performances.

It would be expected that:

- A lack of feedback causes worse performances so that players are making less progress.
- A fast-action puzzle game that lasts too long without changes in the gameplay or is too easy causes boredom.
- A fast-action puzzle game that lasts too short so that players are not able to get familiar with the mechanics or is too hard causes frustration.
- A lack of practice so that a player does not know what to do causes frustration.
- A fast-action puzzle game should begin in an easier mode in order to provide the user with the time to practice to get started.
- Difficulty should be increased slowly and gradually over time in order for players to manage succeeding at higher difficulties levels.
- A lack of choices for players to make gameplay decisions in a fast-action puzzle game causes boredom, less engagement and a worse performance.
- A lack of quantity and quality of graphics, sound, animation and music causes boredom or unwillingness to succeed.
2 Research

Several researched articles and literature served as guideline on which design principles and concepts should been implemented for the prototype that was used in this study. The topics that were studied were: game design, fundamentals of game design, design principles, the fast-action puzzle genre, the Flow Theory and affective learning.

2.1 Literature Review

Literature such as "Fundamentals of Game Design" and "The Art of Game Design: A Book of Lenses" were used. All used keywords and databases are included below.

- Game Design (ProQuest Ebook Central, ACM Digital Library, Emerald Insight, ScienceDirect)
- Puzzle Game Design (ACM Digital Library, Emerald Insight)
- Design Patterns (ProQuest Ebook Central, ACM Digital Library)
- Design Principles (Gamasutra)
- Design Framework (Gamasutra)
- Flow Theory (ProQuest Ebook Central, ACM Digital Library)
- Gameflow (ACM Digital Library)
- Video Games (ProQuest Ebook Central, ACM Digital Library)
- Players (ProQuest Ebook Central, ACM Digital Library)
- Puzzle Game (Scopus, Science Direct)

<table>
<thead>
<tr>
<th>Database</th>
<th>Keywords</th>
<th>Results</th>
<th>Abstract Only</th>
<th>Used Articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProQuest Ebook Central</td>
<td>Game Design, Design Patterns, Flow Theory, Video Games, Players</td>
<td>415.818</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>ACM Digital Library</td>
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<td>Emerald Insight</td>
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<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Science Direct</td>
<td>Game Design, Puzzle Game</td>
<td>150.465</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Scopus</td>
<td>Puzzle Game</td>
<td>1.897</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Gamasutra</td>
<td>Design Principles, Design Framework</td>
<td>2.183</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

All articles that have been read (abstract only or used within the thesis) have been saved as a backup when possible in case the online source might have been removed.
2.2 Defining Fast-Action Puzzle

The action genre is considered to be focused on presenting challenges that test the player’s skills and coordination through for example puzzle-solving, tactical conflict and exploration (Adams 2010). Puzzles are often present in all kind of genres, such as in the action genre where players would for example need to figure out the weakness of a boss or how access to other areas should be unlocked (Adams 2010). Puzzle games focuses on keeping players busy with hours of strategy and problem solving (Adams 2010). Puzzle games often include pressure in the form of time limits and physical coordination, especially combined together where players have a limited amount of time to provide input, which are considered features from the Action genre (Adams 2010). Puzzle games are defined by having recognizable patterns, through making logical deductions and understanding the process on how to clear a puzzle (Adams 2010).

Adams (2010) suggests that a game can borrow features from multiple genres rather than trying to be one exclusive genre. One of the most successful hybrid genres is the action-adventure genre, which includes for example The Legend of Zelda series (Adams 2010).

Multiple genres are often merged together in order to appeal to a larger audience, where the inclusion of story and puzzles is not uncommon for most genres. The risk however is that rather than appealing to multiple audiences you end up appealing to none of them (Adams 2010). Time limits are commonly used for action games with the intention of providing a sense of urgency or to indicate a major event (Adams 2010).

Other common features for action games are a score counter and victory conditions and are often utilized together. A certain score might be required as a victory condition. However, not all games are winnable such as Space Invaders which keeps on going endlessly while raising the speed and difficulty over time until the player no longer can keep up and eventually will lose (Adams 2010).

Based on Adams literature a fast-action puzzle game would be defined by including the following features from both the action and puzzle genres:

- Time limits (Action)
- Score counter (Action)
- Victory condition or endless playability until the player eventually loses (Action)
- Problem solving (Puzzle)
- Strategy (Puzzle)
- Physical coordination (Action / Puzzle)
- Recognizable patterns (Puzzle)
- Making logical deductions (Puzzle)
- Understanding a process (Puzzle)
- Making a game harder and / or faster over time (Fast)
- Short sessions that can be extended (Fast)

These listed gameplay elements were considered for the implementation of the prototype used in this study in order to function as a game within the fast-action puzzle genre.
2.3 Game Design & Fundamentals of Game Design

The development of a game should follow a set of guidelines to make them be more engaging to play. Certain game design principles should applied during development rather than afterwards when the production has been completed and the game is released (Bates 2004). Games are supposed to be fair, which should be achieved by properly balancing a game and preventing systems from cheating against the player (Adams 2010). A list of design principles from Adams and Bates has been listed below:


- **Player Empathy**: How developers would react to a situation if they were the player.
- **Feedback**: Every action should result into a response. If you hit an enemy you should see a visual indication that the enemy has been hit.
- **Grounding the Player**: Players should know what they are doing and where they are. Include a map to indicate the player’s position to prevent them from getting lost.
- **Momentarily Experience**: Known as Moment-to-Moment. Players should not feel bored at any moment, which causes them to stop playing. Do not make challenges too hard or easy and avoid reusing object too often.
- **Immersion**: If a game is compelling and players want to continue playing they forget the physical world they exist in and lose track of time.
- **Impediments**: Do not limit players with technical limitations such as disc swapping, loading times, poor interfaces, limited saving and bugs.
- **Interface Design**: Interfaces should be simple, logical and locatable and must decide how to convey information so that players know how to react.
- **Start-Up Screen**: New players have to learn to go through the essentials while experienced players want to get started quickly.
- **Customize Controls**: Players have their own preferences for interaction depending on their peripherals. Different hardware demands different settings. Never assume that players know what each setting does.
- **Practice**: Some players need guidance and should be provided with the tools to help them to get started. Make the early game serve as a tutorial.

Adams (2010)

- **Pacing**: Vary the pacing of the game by throwing in some variation over time.
- **Difficulty**: Provides the player with the resources to tackle higher challenges. In addition, allow players to adjust or influence the difficulty of the game.
- **Elements**: Do not use elements which do not make sense.
- **Goals**: Inform the short-term goals.
- **Choice**: Inform about the risk, reward and consequence of choices. A player can not or will not make a proper choice when he is not sure what the outcome might be.
- **Reward**: Reward players for performing well. Be generous in rewarding them and do not punish them too harshly. Rewards are more efficient than punishments.
• **Foreground**: The playing field should have the focus over the background.

• **Artificial Opponent**: It should offer a good challenge and then lose. An unbeatable level is not fun.

A research by Duarte (2017) that lasted 40 hours with 14 participants with sessions of four hours was held with the goal to recognize and define distinctive features. For this research, Duarte had to analyze a set of design principles:

**Duarte (2017)**

• **Balanced**: Chances of winning are equal for each player.

• **Rewarded Experience**: Continue playing improves a player’s skill.

• **Random**: Provide a sense of uniqueness, yet controllable and predictable.

• **Possible Strategies**: Multiple strategies can be used to win, thus having choices.

• **Worthwhile Strategies**: There are multiple strategies that are worth considering.

• **Symmetric**: All players are treated equally by what the game provides them with.

• **Present Theme**: The game has a theme that is presented.

• **Relevant Theme**: The theme of the game matches expectations.

Adams (2010) states that players should have sufficient time to think over their actions and choice for puzzle games. Scott Kim’s Eight Steps (Adams 2010) provides a hierarchy in which a puzzle game should identify it’s game design. Technology should be valued for what it adds to the puzzle genre (Adams 2010).

Below are listed five of Kim’s Eight Steps (Adams 2010) which follows Adams and Bates design principles that are listed above:

2. **Simplify** Feedback (be clear, keep it simple and effective)

2. **Simplify** Do not use elements which do not make sense (avoid confusion)

4. **Define the rules** Grounding the Player

4. **Define the rules** Inform the short-term goals

4. **Define the rules** Reward large and punish small

5. **Puzzle construction** Vary the pacing

5. **Puzzle construction** Reward good players

6. **Test** Player Empathy

6. **Test** Inform about the risk, reward and consequence of choices

6. **Test** Practice (make the early game serve as a tutorial)

8. **Presentation** Immersion (storytelling and graphics)

8. **Presentation** Interface Design

8. **Presentation** The Start-Up Screen
2.4 Flow Theory, Evolution & Creativity: or, ’Fun & Games’

The Flow Theory is referred to as a situation where a user engages himself with an activity and enters into a state of flow. This is achieved when there is a balance between the challenge of the activity and the capabilities of the user. A challenge that is higher than what the user is capable of can result in anxiety. Likewise, a challenge that is lower than what the user is capable of can result in boredom. Challenges should match the capabilities of users throughout the duration of the activity (Velikovsky 2014).

Engaging in a self-rewarding activity can evoke a state of flow, which could achieved by overcoming a challenge in which the reward from completing it is not the goal or motivation. Playing on a higher difficulty may not have any additional in-game rewards, yet players can find difficulties that are more challenging be rewarding because of their ability to overcome them. The player’s satisfaction of overcoming difficult challenges would be even more if only a minority of players were able to overcome them (Velikovsky 2014).

A state of flow is not exclusive to physical challenges. It can be a mental state of mind as well where the player engages himself into the story of the game and is able to follow it along. The flow state can be enhanced here if the story for example manages to tie itself into the game cohesively with it’s mechanics (Velikovsky 2014).

Varonis (2015) described that a state of flow is achieved when there are clear proximal goals and when there is immediate feedback. Feelings such as enjoyment, immersion, presence, flow and arousal are all similar in that they emphasize on different aspects of the player’s subjective experiences (Velikovsky 2014).
A flow state is typically specified by the following characteristics (Velikovsky 2014):

- Clear goals
- Immediate feedback on actions
- Balance between challenge and skill
- Actions and awareness are merged
- Distractions are excluded from the consciousness
- No worry of failure
- No self-consciousness
- Distorted sense of time
- The activity becomes the purpose and goal

Game design is seen as a form of cognitive play with patterns where gameplay puzzles, rules and behavior are designed. The state of flow from designing games can be observed by players, as they can feel encouraged to replay stages or challenges in order to experience a similar state of flow (Velikovsky 2014).

2.5 Understanding game design for affective learning

Affective learning is a design method in which games are used to educate players through feeling and emotion. The term affective refers to expressing feelings and emotion. The use of affective learning also applies to commercial games with no seemingly connection to education. All games use mechanics and in order for players to succeed going through these mechanics they have to be understood by the players (Dormann 2008). A game should make it as clear as possible how to solve a puzzle through interacting with the several mechanics used within a game, without giving the answer away. A cognitive walkthrough is a method where the user interface is evaluated to understand how easy it is to perform certain goals (Dormann 2008). Players who get stuck in a game because they did not understand the mechanics might lose their interest to continue. Affective learning could be vital for achieving a high engagement with a game.

A designer might ask himself in the scenario of the puzzle (Dormann 2008):

- Are players trying to solve the issue in the intended manner?
- Are players aware that there is a correct solution?
- Can players understand which is the intended action for the correct solution?
- Will players understand that executing an intended action causes them to continue?
Welcome to the Memory Game Mash-Up experiment! Please take your time go complete all six rounds.

Each new round brings some changes to the gameplay and/or presentation.

**Rules**

- Use left mouse button to click on bricks in order to swap them
- If two equal bricks are swapped:
  - You gain points (equal to the value of the set)
  - You gain additional time
  - Both bricks are removed
- If you empty a whole row of bricks:
  - You gain a larger amount of additional time than usual
  - All bricks reset
  - The difficulty can increase
- A higher difficulty means:
  - You played long enough to advance
  - More bricks are added into the field

*Please 'Run Test' to begin the game.*

Figure 2: Instructions for participating with the experiment
3 Translating Game Design

In order to study the value of design principles they have to interpreted and translated for implementation in the prototype which has six different presets, where each preset changes a different part of the game’s design. Each preset therefore has their own separate changes regarding the rules and presentation of the prototype. Game balance is important according to Shell (2008) and will have a major part in the prototype. Users will experience all available presets in a random order which is differently each time the experiment starts.

Presets were randomized to prevent bias. Players might not yet be familiar with the game yet during the first minute. The first preset could therefore have worse results. In the second iteration of the prototype the preset Default will always be the first preset, which was chosen because it is the preset that should contain no changes and will therefore will as an introduction to the prototype. The other presets are still randomized to avoid bias.

Design principles were chosen from section 2.3 and were considered how they could be used within the design of a fast-action puzzle game. A few design principles were not practical to use within the prototype. Not because they did not have any value, but because the specific type and scope of the development of the prototype could not support it. For example, Grounding the Player did not seem like suitable fit since there is no ”game-world” to get lost into. The scope of the game was not large enough for the prototype’s design to make a series of complex mechanics to get lost into. Presets were introduced with quick instructions as part of the Start-Up Screen principle. There were no opponents to puzzle against so any design principles for artificial or human opponents were excluded.

Design principles for presets were chosen on how they would fit the goal of each preset and how practical it was to implement those within the given scope, resources and time of the design of the prototype.

3.1 Default Gameplay Mechanics

Based on the research of section 2.2 the following gameplay mechanics were utilized for the fast-action puzzle game prototype.
<table>
<thead>
<tr>
<th>Mechanic</th>
<th>Genre</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swap Cards</td>
<td>Memory</td>
<td>Remember where each card belongs and match them.</td>
</tr>
<tr>
<td>Clear Row / Column</td>
<td>Puzzle</td>
<td>Clear all cards in a row or column to gain extra time and advance to the next difficulty</td>
</tr>
<tr>
<td>Skip Cards</td>
<td>Puzzle</td>
<td>A feature with limited use for consideration, strategy &amp; choice to clear a field easier or faster</td>
</tr>
<tr>
<td>Timer</td>
<td>Action</td>
<td>Haste the player to perform as well he can within the given time</td>
</tr>
<tr>
<td>Score</td>
<td>Action</td>
<td>Motivate the user to perform better than his last attempt or that of others</td>
</tr>
<tr>
<td>Losing</td>
<td>Action</td>
<td>The players loses when time runs out</td>
</tr>
<tr>
<td>Earning Additional Time</td>
<td>Action / Faster</td>
<td>Prevent players from losing by letting them continue further</td>
</tr>
<tr>
<td>Victory</td>
<td>Action</td>
<td>Clear cards to advance to the next difficulty</td>
</tr>
<tr>
<td>Difficulty</td>
<td>Action / Faster</td>
<td>Keep making the game harder until the player eventually loses</td>
</tr>
</tbody>
</table>

An online leaderboard is not present within the prototype, thus preventing users from comparing scores with each other. Preferable this would be presented at the end of each preset. This functionality was considered out of scope of the study. However, the score is still intended to motivate users to perform better.

A maximum time limit of two minutes was enforced in the second iteration of the prototype (see section 3.2) to prevent the experiment from lasting too long as it would cause users to lose the motivation to complete their participation. Ideally, no maximum time limit should be enforced upon a fully-realized version of the game.

### 3.2 Changes in the Second Iteration

A second iteration had been designed based on the results that were analyzed from the gameplay data and survey answers of the participants. The second iteration was tested on a new group of participants after the conclusion of the first iteration. All four methods (Data Collection, Surveys, Observations and Interviews) were applied again for the second iteration. Therefore the results are split into two parts: Iteration 1 and Iteration 2.

The list of changes that have been made to the second iteration of the prototype:

- Removed user accounts. The prototype can be fully played without one. Users can provide an email optionally during the survey for further contact.
- Removed mandatory PHP and MySQL code. It is optional so that servers without support are functional too. Servers with support still store data on a MySQL server.
- Store the IP address of the user for each played session in order to distinguish users. This function only works on PHP supported servers.
- Users are now asked to answer how they thought about each preset immediately after playing it. Once the user is re-directed to the survey those questions they answered during playing the prototype will already be filled in.
• Limited the affect on the behavior of the prototype by altering it’s code in runtime.
• Made the game cards bigger for improved visibility.
• Motivate choice by allowing users to clear either a row or column of cards to advance.
• Limit each preset to a maximum of two minutes to motivate users not to give up.
• Speed-up gameplay by advancing to the next difficulties faster.
• Track additional statistics such as the amount of times fields were cleared, skips were used or the game was paused.
• Motivate puzzle design through the "Skip Cards” feature. Players can skip cards with the right mouse button if having difficulties remembering their positions.
• Enhanced and additional visual backgrounds, sounds, music and animations. Audio-visual should now have a clearer difference when this is all taken away.
• Additional rules and changes for each preset to make them more distinguished from each other.
• Default is now always the first preset in order to ease players into the game.
• Simplify and visualize the presentation of the instructions and rules. Keep it concise.
• Survey questions directly related to the played presets are now answered after each completed preset.

The goal with this iteration was to:

• Re-enforce the Puzzle genre through allowing for more choice and strategy.
• Fix critical bugs.
• Make it easier for participants to remember which preset they just played.
• Make it easier for new participants to get into the experiment.
• Further distinguish each preset.

The following images illustrate the second iteration of the prototype.

Figure 4: Prototype of the experiment, which shows the game in action
3.3 Preset 1: Default

This preset is without any game design alterations. Each preset will be focusing on changing a part of the game’s design so there has to be at least one preset where the game is experienced as should be intended (see section 3.1).

In the second iteration of the prototype this preset will always be presented first in order to ease the player into the game. Since no changes were made yet, the player should be able to understand how the subsequent presets changes their experience with the game.

**Difficulty for Default, Choices, Static Time & Audiovisual**
Awarded 5 extra seconds for clearing cards, 45 seconds can be stored on the timer, there are 5 seconds to preview all cards each round, the difficulty level starts on Easy (2) with a maximum to Very Hard (6) and the difficulty proceeds after an average of 30 card swaps.
3.4 Preset 2: Easier

The game was made easier during this preset in order to study if players are still staying engaged if the game has become too easy. The game will be made easier by keeping time limits higher and the amount of cards lower than usual. A game that is made too easy might not be engaging anymore. This would result in players to not be interested enough anymore to increase their performance such as gaining more points.

<table>
<thead>
<tr>
<th>Design Principle</th>
<th>Effect</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choice</td>
<td>Easier to make a choice</td>
<td>Allow the player to see all cards longer than usual at the start of each round</td>
</tr>
<tr>
<td>Difficulty</td>
<td>Easier to play</td>
<td>The game starts out easier and will not continue to the highest difficulty</td>
</tr>
<tr>
<td>Difficulty</td>
<td>Easier to play</td>
<td>Start with one additional skip use (iteration 2)</td>
</tr>
<tr>
<td>Reward</td>
<td>More time to think</td>
<td>More time than usual is rewarded for clearing card sets and the field</td>
</tr>
<tr>
<td>Practice</td>
<td>Easier to start as a new player</td>
<td>Due to the much lower starting difficulty and additional starting time players card afford more mistakes before losing to learn the game</td>
</tr>
<tr>
<td>Momentarily</td>
<td>Bored</td>
<td>The game stays easier for much longer than usual which could make the game boring</td>
</tr>
<tr>
<td>Experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacing</td>
<td>Going slower</td>
<td>The game proceeds slower to the next difficulty and causes players to wait more often</td>
</tr>
</tbody>
</table>

This results in requiring less memorization skills and a larger window of time to plan the next action. It is expected that players will get bored and stop playing when a game lacks sufficient challenge (Shell 2008).

Paper puzzle games have been used for decades, where traits such as easy accessibility, minimal requirement of learnability and skill are central (Johnson 2019). The goal was to translate that design into a game on a digital platform.

**Difficulty Changes**
Awarded 6 extra seconds for clearing cards, 50 seconds can be stored on the timer, there are 7 seconds to preview all cards each round, the difficulty level starts on Very Easy (1) with a maximum to Hard (5) and the difficulty proceeds after an average of 40 card swaps.

3.5 Preset 3: Harder

Instead of making it easier, it could be expected that making it much more difficult causes an opposite but similar effect. Similar as with making a game too easy, a difficulty that is too high could cause players to lose the interest to increase their performance as well. Games that are more difficult could also act as a motivation to perform better. Players could prefer a harder challenge instead of an easier one.
<table>
<thead>
<tr>
<th>Design Principle</th>
<th>Effect</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choice</td>
<td>Harder to make a choice</td>
<td>Cards are only shown very briefly at the start of each round</td>
</tr>
<tr>
<td>Choice</td>
<td>Careful Consideration</td>
<td>Limited to only skipping cards three times during this preset (iteration 2)</td>
</tr>
<tr>
<td>Difficulty</td>
<td>Harder to play</td>
<td>The game starts out harder and can continue to a difficulty even higher than usual</td>
</tr>
<tr>
<td>Reward</td>
<td>Less time to think</td>
<td>Less time than usual is rewarded for clearing card sets and the field</td>
</tr>
<tr>
<td>Momentarily</td>
<td>Anxious</td>
<td>The game gets harder for much faster than usual which could make the player feel anxious</td>
</tr>
<tr>
<td>Experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacing</td>
<td>Going faster</td>
<td>The game proceeds faster to the next difficulty and forces playing to constantly gain earn time</td>
</tr>
</tbody>
</table>

The game will be made more difficult by decreasing the time limit as well as the time awarded for clearing card sets and rows. The game will also have a larger amount of cards which will require better memorization skills and should require more time to clear a row within the smaller time limit. It is expected that players will get anxious and stop playing when a game is too difficult (Adams 2010). A game that is cruel and harsh could also act as a motivator to try it one more time. If the player then finally succeeds their satisfaction for it will be larger (Varonis 2015).

**Difficulty Changes**

Awarded 4 extra seconds for clearing cards, 40 seconds can be stored on the timer, there are 3 seconds to preview all cards each round, the difficulty level starts on Medium (3) with a maximum to Insane (7) and the difficulty proceeds after an average of 20 card swaps.

### 3.6 Preset 4: Choices

For this preset the amount of choices players can make will be reduced. In order to study how the game compares. The game should be played more linearly when there are fewer choices to make by the players.

<table>
<thead>
<tr>
<th>Design Principle</th>
<th>Effect</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choice</td>
<td>Remove choice</td>
<td>All cards must be cleared to proceed (iteration 1)</td>
</tr>
<tr>
<td>Choice</td>
<td>Remove choice</td>
<td>A set amount of cards per difficulty must be cleared to proceed (iteration 2)</td>
</tr>
<tr>
<td>Choice</td>
<td>Remove choice</td>
<td>All cleared sets grant an equal of points</td>
</tr>
<tr>
<td>Choice</td>
<td>Careful Consideration</td>
<td>Only limited to one skip each new field of cards (iteration 2)</td>
</tr>
<tr>
<td>Possible</td>
<td>Linearity</td>
<td>Simplifying gameplay leads to fewer strategies</td>
</tr>
<tr>
<td>Strategies</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Shell (2008) argues that choices matter. This preset will reduce the amount of choices players can make through simplifying the mechanics and adding limitations. Normally the player has to clear one row or column of cards so that the field resets to advance. Instead the player has to clear a specific number of cards each round to reset the field. This results in the player to lower the focus on the most effective method to clear the field. In addition every cleared set of cards grants the same amount of points instead of the value shown on the front.

Cards have the value which they are presented with. There are a total of 53 cards (Hearts, Diamonds, Spades and Clubs, plus the Joker, each valued from 1 to 14). This gives players the opportunity to decide to aim for higher value cards while clearing a row to obtain a higher score. If each card grants the same amount of points then players should no longer consider how to effectively reach for the highest score.

It is expected that if a player has a variety in how to approach a challenge that the player will have a more engaging experience and thus want to keep playing (Adams 2010). Varonis (2015) describes that choices make a player feel like an active participant and an integral part of the game’s world, which increases the immersion. By removing choices a part of the immersion is removed which could negatively affect their engagement and performance.

### 3.7 Preset 5: Static Time

All other presets have a dynamic playtime where the timer is set at around 35 seconds. By clearing card sets and the field more time was added to the timer so that the game keeps playing longer. For this preset the rules surrounding the time were changed so that the game will last a fixed amount of two minutes with no option to gain additional time.

<table>
<thead>
<tr>
<th>Design Principle</th>
<th>Effect</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacing</td>
<td>Variation</td>
<td>The game now runs for a total of two minutes</td>
</tr>
<tr>
<td>Reward</td>
<td>Reward removal</td>
<td>Extra time will no longer be awarded</td>
</tr>
<tr>
<td>Choice</td>
<td>Remove choice</td>
<td>There is no need to consider extra time</td>
</tr>
</tbody>
</table>

The duration of a game’s session has to be in balance (Shell 2008). A game that is too short prevents players from making meaningful decisions and a game that lasts too long gets boring eventually, causing players not wanting to invest their time into it, and even causes choices to be monotonous eventually. Changing restrictions can result in a longer game. Games can be made easier by drawing them out over a longer period of time.

It is expected that timed-based challenges cause pressure. The shorter the timer is the more stressful a situation will be. It is expected that players will experience less stress when there is less pressure and therefore are more likely to continue playing (Adams 2010).

Time must be balanced. When there is too little time, things will move too quickly and players might not make calculated decisions anymore. When there is too much time, there will be a reduced risk since players can calculate their decisions in ease (Varonis 2015). The goal is to test if a fixed time will have a positive or negative effect and if players are spending more time to calculate decisions.
3.8 Preset 6: Audiovisual

For this preset, all graphics, animations, sounds and effects were stripped in order to study if players still perform as well as with the other presets. Players might be bothered by the removal of the audiovisual quality which would result in a reduced performance. Alternatively, the audiovisual presentation might distract the player too much in which case his performance should be increased. Nevertheless it is expected that the engagement of players would be decreased, regardless of the result of the performance.

<table>
<thead>
<tr>
<th>Design Principle</th>
<th>Effect</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedback</td>
<td>Confusion</td>
<td>Sound and animation has been removed to indicate user input</td>
</tr>
<tr>
<td>Immersion</td>
<td>Not feeling playing a game</td>
<td>The visual style has changed to no longer visualize a traditional playing cards deck</td>
</tr>
<tr>
<td>Immersion</td>
<td>Not feeling playing a game</td>
<td>Background graphics and animations have been removed (iteration 2)</td>
</tr>
<tr>
<td>Interface Design</td>
<td>Recognition</td>
<td>Cards use a simplified style to indicate their type and value, causing a lack of recognition</td>
</tr>
<tr>
<td>Foreground</td>
<td>Separation</td>
<td>The background and foreground use a similar style which makes it harder to separate them</td>
</tr>
<tr>
<td>Relevant Theme</td>
<td>Disconnection with the game</td>
<td>Players will less attached and motivated to playing the game</td>
</tr>
</tbody>
</table>

The card deck will be reduced in graphical quality by simplifying the cards as mono-color numbered brick tiles rather presenting them as official deck cards with imagery. The layout of the interface is also graphically simplified by using a simplified mono color for the background without any animated objects.

Visual design is an important aspect of interactive experiences, since they guide the player in remembering and recognizing layouts (Shell 2008). Simplistic mono-color brick tiles were used with it’s value written on top of it. It is expected that a worse presentation might distract the player and causes him to lose the focus to stay engaged with the game. Simplifying the brick tiles might help players to faster understand their value. However it is expected that a simplified presentation prevents the player from grasping any important information due to a lack of focus and engagement (Adams 2010).

A conducted experiment with puzzle games by Carvalho (2012) shown that audiovisual cues are important in order to solve puzzles as it will help users to identify all pieces. The use of audio can affect the strategy for solving puzzles. Different audio samples were used throughout the other presets for when players correctly or incorrectly swap cards. The value of cards also affect which audio samples were used since the second iteration of the prototype. Without sound effect players might not easily recognize the value of cards resulting in a lower score.
4   Methodology

The methods *Data Collection, Surveys, Observations and Interviews* were used to obtain quantitative and results. Qualitative data methods were used in addition since there were a limited amount of participants. Robson (2016) argued that qualitative data is more preferable when there are a limited amount of participants.

4.1   Target Group

The prototype was available for access online on the internet which allowed any person of any background and age to participate. The first iteration of the prototype lacked a background study of the participants. In the second iteration of the prototype a different set of participants were asked after their gender and age group and to participate.

The first iteration of the prototype originally aimed at students of the Linnaeus University (in specific those studying Media or Programming courses) for two primary reasons:

- Easy to contact through the use of communication channels such as FirstClass.
- Background knowledge could increase experience with the experiment.

However due to the lack of a sufficient amount of participants and that a few students tried to change the code of the prototype who were removed from the study (see section 1.2) the experiment furthered opened to participants of any background who were interested. These participants were contacted before sending access information to the prototype.

Background information of the participants was added later in order to be aware of who the participants were and what the target group was, which could improve the design further on. All background information was provided by participants themselves during answering the survey. No other form of background information have been collected. Gameplay statistics which have been collected throughout contained no personal information.

4.2   Description of the Developed Game

A prototype was developed for the purpose of this thesis in order to collect data from participants, with a few of them who were questioned and observed to measure their entertainment and engagement with a fast-action puzzle game. The prototype consists of six different presets in random order lasting a few minutes each. After each concluded preset the next one will commence until all of them have been played through *(see figure 7)*.

The game is intended for web-browsers and serves to research the performance of players:

- Made with HTML5, JavaScript, PHP and MySQL.
- Sessions of a few minutes. Interact and win by earning points.
- Fast-action puzzle memory card mash-up game with a time limit.
- Memorize card positions and swap them to earn points & time until time runs out.
- More cards are added the further a player gets.
- When a row is completed the field resets with new shuffled cards.
The game has six presets where slight alterations occur such as a different interface, different amount of cards or time limit and should affect how the player performs. A preset can be defined as a separate game round with their own individual changes to the prototype such as the gameplay or presentation. These presets are compared with each other to decide which one was the most effective. In order to play a login name and password are required (which can be registered through the prototype). User information was exclusively used to organize statistics for educational purposes.

![Prototype of the experiment, which shows the game in action](image)

User account credentials were provided by the user and consisted of the following: username, password, first name, last name and email (see figure 8). User accounts were removed in the second iteration of the prototype so that it could be played directly (see section: 3.2). Users could instead opt to provide an email address during the survey for further contact.

Participants were able to change their credentials at any time. Only the latest user credentials were stored in a database so that the participant could access the prototype and his game data could be assigned with an unique number ID. Users were able to provide any kind of name, and were not restricted to their real name. Users were allowed to use a throw-away email at the expense of the option to recover their username. Cookies were only used to function as savedata so that participation could resume when it was interrupted.

The prototype was remotely accessible anywhere with internet access. Once the flow of participants which played online stopped a few additional participants were contacted and asked to conduct the experiment in physical proximity of the researcher so that the observation and interview methods could be applied and conducted.

### 4.3 Data Collection Method

Collected data from participants was stored on a MySQL database and included: ratings, amount of points, amount of correct and incorrect swapped card sets, final difficulty level, play time and the amount of time on the timer. Most of the tracked data was also represented in the user interface. The data was then studied and parsed in order to present it’s results and findings. After the completion of the study the database had been completely wiped to protect any potential sensitive information from the participants.
Participants could freely check their results after the conclusion of the experiment, through this function had been removed in the second iteration. Instructions were included within in the prototype on how to start and go through the experiment successfully. Robson (2016) suggested to use other qualitative methods in addition with a lack of participants using quantitative methods.

A login-system was been designed to separate individual users so that each of prototype’s rounds (or ”presets”, see section 4.2) they played could be linked and kept track of. Storing data into a database served as the method to receive, store, read and parse statistical data from users. There was a backup method for obtaining the same data by forwarding it by email in text. Servers used for the prototype capable of PHP could automatize the collection of data. Servers lacking PHP support would require a form of user confirmation to forward the data. After each concluded preset the player will be asked to give it a star rating which will later be referred to in the survey and will be tracked in the database (see figure 9).

Figure 8: The login system that was connected with a database

Figure 9: Setting a rating for a preset once it had been played through
4.4 Surveys Method

The prototype contained a built-in survey after the player has concluded going through all the presets. The survey had been designed to be short, with simple multiple-choice closed questions that are ambiguously phrased and reminded players of their input as suggested by Robson (2016). According to Robson (2016) it should be expected that not every participant would fill in an online survey. Players were reminded in the survey which rating they gave to each preset.

Completed surveys were forwarded automatically to the researcher digitally as an email. The focus was on questions related to the player’s engagement, enjoyment and performance with the game (see figure 10). Questions could lead to follow-up questions similar as with an interview. Players were expected to fill in and submit the survey and were directed towards it once the game had been finished. The survey could be filled in remotely online and followed a structure similarly to that of the semi-structured interview (Robson 2016).

![Figure 10: Example of the survey](image-url)
Questions were formulated as such so that participants had to state their own opinions rather than judging the design itself. The questions had to be formulated as precisely as possible to avoid any misunderstandings (Robson 2016). Questions were aimed to be a self-completing and as closed as possible. This meant that questions only allowed for a limited variation of answers. That could be achieved with closed questions such as with the use of radio- and check-boxes (Robson 2016). This allowed the data to be interpreted more easily and consistently. Surveys were used to complement the statistical data from the Data Collection (see section 4.3) to see if both methods were in unison and that the results led to the same conclusion.

4.5 Observations Method

Four participants (three participants in the first iteration and one participant in the second iteration) were asked to conduct the experiment under the observation of the researcher and afterwards be interviewed about their experience with it. Some studied statistics could not be applied into the Data Collection method such as how participants experienced issues or that they were unaware how to play and have been applied into the Observations and Interviews methods instead.

The researcher observed the participant in proximity going through the experiment so that the behavior for each preset could be observed. Behavior could not be recognized when participating remotely online. During the observation (Robson 2016) of a session the player was left undisturbed and the researcher took notes of how participants interacted.

4.6 Interviews Method

Interviews were conducted in addition to the Observations. The four participants which were observed were also interviewed once they concluded playing. This method was meant to gather additional data which may be lacking from the collected statistics in the database.

Semi-structured interviews (Robson 2016) were used for participants to freely discuss their opinions about the game. A set of questions were prepared to discuss, while also allowing for additional follow-up questions that might seem relevant towards the core questions during the interview. The aim was to gain new insight on what the survey has not or could not have brought up.

Participants were asked a set of questions that included among the following, with some of the questions that were expanded upon:

- Which preset the participant preferred the most and least.
- How the participant would differentiate the best preset from the worst.
- If the participants was content with his result of the earned points.
- If the participant felt he could improve further to obtain a higher score.
- If the participant felt he could execute the puzzles faster to keep the timer higher.
- If the timer led to increased stress.
- If the participant felt he encountered any difficulties.
The survey was simultaneously coded with the prototype and had a limited amount of questions due to time and technical constraints. The questions for the interviews were iterated upon for a while longer after the prototype had been released. Observations and interviews were applied after a few days once the flow of new users stopped with the prototype.

Interviews were stored digitally using qualitative answers and were used to complement the statistical data from the Data Collection to compare if the results arrived at the same conclusion. The aim with the interviews was to study if the opinions of multiple users would agree on the same aspects of the game. Together with the statistics from the Data Collection and the Surveys the prototype could be studied where it was lacking and how it would need to be improved to motivate increased engagement and performance.

4.7 Second Iteration and Goal

The prototype had two iterations. The second iteration was designed to address the issues with the gameplay and design which were analyzed through the results of the first iteration.

- Users had issues that they could not remember which parts of the prototype they had played and suggested questions relevant to these parts would had to be asked during those parts and not afterwards.

- Registering and logging in with an account proved to be an issue for users, making the process to participate slower. The majority of users rather did not use their real names (this would require a change of the Data Collection method described in 4.3).

- Gameplay lasted too long, especially on the easier difficulties. This caused a risk that participants were not focused anymore.

- There was a lack of puzzle elements. New mechanics would need to be added to motivate choice in order to resemble a fast-action puzzle game as described in 2.2.

- The prototype was underwhelming in it’s presentation (graphics and audio), which had two separate issues (see sections 5.1.2 and 5.2.2):
  - Players were less focused with a poor presentation.
  - A lack of distinguish during the part the game removes the presentation.

- There was no background check. It’s was not intended to be used for analyze, but that should not be a reason to not include it. This additional data might prove useful for further studies or references.

- Some participants were found cheating through modifying code in real-time. This was a flaw in the design of the prototype. To ensure no invalid results would be included, this issue had to be dealt with.

- Bugs might have impacted user results. It is unknown if this happened. To be completely sure, a new iteration would have to be tested.

- Users did not always read the instructions. It had too much text.

Section 3.2 describes which changes have been made to the system, gameplay, mechanics and survey. These changes were motivated on the recognized issues described within this section. The goal was to redo the study once more with the same methodology but with fewer limitations. A new set of participants were selected to prevent a bias.
5 Results

A total of 16 users (see table 2) have participated in the first iteration of the prototype and survey for the collection of data. Conducted runs only consist out of statistical data. Surveys, observations and interviews were used to complement the statistical data and see if those were in unison.

Table 2: Participants (2019) - Iteration 1

<table>
<thead>
<tr>
<th>Participant</th>
<th>Date</th>
<th>Hour</th>
<th>Participant</th>
<th>Date</th>
<th>Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>10 April</td>
<td>21:30</td>
<td>02</td>
<td>11 April</td>
<td>11:52</td>
</tr>
<tr>
<td>03</td>
<td>14 April</td>
<td>10:57</td>
<td>04</td>
<td>15 April</td>
<td>10:06</td>
</tr>
<tr>
<td>05</td>
<td>15 April</td>
<td>11:05</td>
<td>06</td>
<td>15 April</td>
<td>11:10</td>
</tr>
<tr>
<td>07</td>
<td>15 April</td>
<td>14:15</td>
<td>08</td>
<td>15 April</td>
<td>14:42</td>
</tr>
<tr>
<td>09</td>
<td>16 April</td>
<td>13:20</td>
<td>10</td>
<td>16 April</td>
<td>20:36</td>
</tr>
<tr>
<td>11</td>
<td>17 April</td>
<td>08:46</td>
<td>12</td>
<td>20 April</td>
<td>16:05</td>
</tr>
<tr>
<td>13</td>
<td>22 April</td>
<td>16:37</td>
<td>14</td>
<td>25 April</td>
<td>20:28</td>
</tr>
<tr>
<td>15</td>
<td>26 April</td>
<td>10:55</td>
<td>16</td>
<td>29 April</td>
<td>15:54</td>
</tr>
</tbody>
</table>

A total of 10 users (see table 2) have participated in the second iteration of the prototype and survey for the collection of data.

Table 3: Participants (2019) - Iteration 2

<table>
<thead>
<tr>
<th>Participant</th>
<th>Date</th>
<th>Hour</th>
<th>Participant</th>
<th>Date</th>
<th>Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>26 June</td>
<td>16:07</td>
<td>02</td>
<td>27 June</td>
<td>11:03</td>
</tr>
<tr>
<td>03</td>
<td>27 June</td>
<td>18:51</td>
<td>04</td>
<td>29 June</td>
<td>10:03</td>
</tr>
<tr>
<td>05</td>
<td>30 June</td>
<td>12:09</td>
<td>06</td>
<td>30 June</td>
<td>13:12</td>
</tr>
<tr>
<td>07</td>
<td>30 June</td>
<td>18:22</td>
<td>08</td>
<td>1 July</td>
<td>08:59</td>
</tr>
<tr>
<td>09</td>
<td>3 July</td>
<td>08:57</td>
<td>10</td>
<td>18 July</td>
<td>20:06</td>
</tr>
</tbody>
</table>

As described in section 3 a complete run consisted out of playing through six different presets in random order: Default, Easier, Harder, Choices, Static Time & Audiovisual. Results were calculated by assigning the used presets for a statistic with rank values. The preset with the highest rank value would have performed the best. Each preset per user is assigned with a rank value between 1 and the amount of used presets for a statistic, where the highest rank value would be incremented to the best performing preset and vice versa.

The average for each preset is calculated by incrementing each preset with a rank value between 1 and 6 (or between 1 and 5 when there were only five studied presets for a statistic), where the preset with the highest rank value is incremented by 6 and the preset with the lowest value is incremented by 1. Appendixes A, B and C display the values that were assigned for each preset as an average and for each user.

If multiple presets share the same rank value then those presets are incremented with the median of their rank (presets sharing the same rank value result in the same rank as its median). The final rank for each statistic per preset was determined by the ascending order of their median. Since different players had different skill levels and obtained points ranging from two to four digits comparing ranks would be too far apart.
5.1 Results of Iteration 1

*Easier* managed to reach the highest rank the most often for all the studied statistics and was followed by *Static Time* as the most often. The average values for swapped card sets for each preset were divided by their average played time (see figure 14).

The difficulty changes between these presets were not drastic (see sections 3.3, 3.4 and 3.5) yet participants found that the changes for *Harder* was their threshold which was the limit where their experience suddenly turned into stress. *Harder* has the lowest played time and lowest score points among all presets (see figure 16).

![Highest Star Rating (Average)](image1)

Figure 11: Highest Rating as an average

![Highest Points (Average)](image2)

Figure 12: Highest Points as an average
Figure 13: Highest Correct, Incorrect & Ratio (correct divided by incorrect) of Swapped Card Sets as an average

Figure 14: Highest Correct, Incorrect & Ratio (correct divided by incorrect) of Swapped Card Sets if each presets lasted as long as Default
Figure 15: Highest Played Time and Highest Remaining Time on the Timer as an average

Figure 16: Highest Time Played in seconds as an average
5.1.1 A Quick Summary

The preset: Static Time had the highest rating.
The preset: Easier had the highest amount of points.
The preset: Easier had the most correct swapped card sets.
The preset: Static Time had the most incorrect swapped card sets.
The preset: Choices had the highest ratio of correct swapped card sets.
The preset: Easier had the most difficulty increases.
The preset: Easier had the highest time on the timer.
The preset: Easier had the highest played time.

The preset: Harder ranked the lowest for all statistics. The following presets managed to rank at the second lowest place:

The preset: Audiovisual had the second lowest rating.
The preset: Audiovisual had the second lowest amount of points.
The preset: Default had the second fewest correct swapped card sets.
The preset: Default had the second fewest incorrect swapped card sets.
The preset: Audiovisual had the second lowest ratio of correct swapped card sets.
The preset: Audiovisual had the second fewest difficulty increases.
The preset: Audiovisual had the lowest highest time on the timer.
The preset: Default had the second lowest played time.

5.1.2 Surveys

In addition to playing the game participants were asked to fill in a survey at the end of a conducted run (see appendix D). The following results were obtained from them:

Easier was chosen by 67% of the users as the most enjoyable preset because of the more forgiving timer, lower difficulty and much less stress. The more forgiving timer made this preset the easiest to understand since users had more time to observe the goal. The majority stated that they had the most fun playing this particular preset.

Harder was chosen by 56% of the users as the least enjoyable preset because the timer was too frustrating which had too little time for affording mistakes and was considered to have caused the most stress. Audiovisual was opted as the second least enjoyable preset because of a lack of memorable visuals and audio that made it boring. 78% of the users agreed that the difficulty of the overall game was fine.

Easier was agreed by the majority to gave them the least amount of issues. It still provided a sufficient challenge and did not take too long, despite the length that was drawn out because earning additional time was easier. Easier lasted an average of 3.5 minutes per user while Harder roughly lasted 1 minute for most users. Because of the higher difficulty of Harder the played time was decreased by 69% compared to Easier. No preset was considered to last too long according to the participants, even during Easier.

67% of the users agreed that Choices was fun to play. In addition one-third of the users agreed that it was innovative, easy enough to understand and was not stressed by the timer and 42% agreed it had the right challenge.

Half of the users agreed that Static Time had the right duration and challenge. In addition 58% had fun playing it and one-third of the users was not stressed by the timer.
Figure 17: Presets which were the most and least enjoyed during the survey

Figure 18: Issues presented during the survey
5.1.3 Interviews

The data from the three held interviews (see figure 19 and appendix E) suggest to support the idea that removing the choice which cards to clear was not that important since participants were focused on clearing cards just for the sake of clearing cards. Earning points and advancing to the next difficulty level did not matter that much and was considered as something that would occur naturally over time.

The interviewed participants had no issue getting into the game on their own and that they had no issue playing it, with a few of them even mentioning it was very fun to do so. The interviewed participants suggested to see no major flaws that prevented them from enjoying the game itself on a basic level, so that when certain presets presented a negative outcome it would be due to the changes introduced during that preset.

The interviewed participants also agreed that they could have performed better because they were not familiar with the rules and interface that the experiment used. They think that they would have been able to perform much better on subsequent runs. Because the experiment felt new to them the first time participants were losing a few valuable seconds to get properly started in each preset. The participants required a short moment to getting accustomed to the game’s interface before properly commencing the next preset.

<table>
<thead>
<tr>
<th>Interviews - Agreeing Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Played Memory Before</td>
</tr>
<tr>
<td>More Stressed Over Time</td>
</tr>
<tr>
<td>Wanted To Retry</td>
</tr>
<tr>
<td>Wanted To Quit</td>
</tr>
<tr>
<td>Could Preform Better</td>
</tr>
<tr>
<td>Lost Focus</td>
</tr>
<tr>
<td>Understood The Rules</td>
</tr>
<tr>
<td>Could Get Started Alone</td>
</tr>
<tr>
<td>Had Fun</td>
</tr>
</tbody>
</table>

Figure 19: Summary of agreed opinions from the three interviews
5.2 Results of Iteration 2

With the second iteration of the prototype, a second set of results were obtained. Similar as with the previous iteration *Average Per Sec* rank values were determined the average and standardized playtime for all presets.

![Highest Star Rating (Average)](image)

*Figure 20: Highest Rating as an average*

![Highest Points (Average)](image)

*Figure 21: Highest Obtained Total Points and Obtained Card Values as an average*
Figure 22: Highest Obtained Total Points and Obtained Card Values if each presets lasted as long as Default

Figure 23: Highest Amount of Used and Maximum Skips as an average
Figure 24: Highest Obtained Level and Level Increases as an average

Figure 25: Highest Used Game Pauses as an average
Figure 26: Highest Correct, Failed & Ratio (correct divided by incorrect) of Swapped Card Sets as an average

Figure 27: Highest Correct, Failed & Ratio (correct divided by incorrect) of Swapped Card Sets if each preset lasted as long as Default
Figure 28: Highest Time Played and Highest Timer as an average

Figure 29: Highest Time Played in seconds as an average
Easier managed to reach the highest score most often for all the statistics that were studied, which was followed by Static Time on a second place for most statistics.

The difficulty changes between these presets were not drastic (see sections 3.3, 3.4 and 3.5) yet participants found that the changes for Harder was their threshold which was the limit where their experience suddenly turned into stress. Harder has the lowest played time and lowest score points among all presets (see figure 16).

5.2.1 A Quick Summary

Easier still managed to rank the highest most often, however this time Choices and Static Time managed to rank the highest a considerable amount of times more.

The preset: Default had the highest rating.
The preset: Choices had the highest amount of points.
The preset: Static Time had the highest value of swapped card sets.
The preset: Choices had the highest amount of points (average per sec).
The preset: Choices had the most used skips.
The preset: Easier had the most available skips.
The preset: Audiovisual had the most used of the maximum available skips.
The preset: Choices had the highest reached level.
The preset: Choices had the most level advances.
The preset: Easier had most fields cleared of cards.
Presets: Default, Easier, Harder & Static Time were paused the most.
The preset: Easier had the most correct swapped card sets.
The preset: Static Time had the most incorrect swapped card sets.
The preset: Easier had the highest ratio of correct swapped card sets.
The preset: Easier had the most correct swapped card sets (average per sec).
The preset: Audiovisual had the most incorrect swapped card sets (average per sec).
The preset: Easier had the highest ratio of correct swapped card sets (avg. per sec).
The preset: Easier had the highest played time.
The preset: Easier had the highest remaining time on the short clock.
The preset: Easier had the lowest remaining time on the 2-minute clock.

Once again Harder managed to rank the lowest most of the time, followed by Audiovisual. These results were not that different compared to the first iteration.

The preset: Audiovisual had the lowest rating.
The preset: Harder had the lowest amount of points.
The preset: Harder had the lowest value of swapped card sets.
The preset: Audiovisual had the lowest amount of points (average per sec).
The preset: Static Time had the fewest used skips.
The preset: Default & Audiovisual had the fewest available skips.
The preset: Harder had the fewest used of the maximum available skips.
The preset: Easier had the lowest reached level.
The preset: Harder had the fewest level advances.
The preset: Harder had fewest fields cleared of cards.
Presets: Choices & Audiovisual were paused the least.
The preset: Harder had the fewest correct swapped card sets.
The preset: Harder had the fewest incorrect swapped card sets.
The preset: Harder had the lowest ratio of correct swapped card sets.
The preset: *Harder* had the fewest correct swapped card sets (average per sec).
The preset: *Easier* had the fewest incorrect swapped card sets (average per sec).
The preset: *Audiovisual* had the lowest ratio of correct swapped card sets (avg. per sec).
The preset: *Harder* had the lowest played time.
The preset: *Harder* had the lowest remaining time on the short clock.
The preset: *Harder* had the highest remaining time on the 2-minute clock.

*Notes:* The 2-minute clock should reach 00:00 for the best performance, indicating that the round was successfully completed. The short clock should stay above 00:00 since its expire causes the round to end prematurely. Since the preset *Static Time* does not include the short clock, that preset had been removed in clock-related results. Similarly *Choices* always provides a consistent value of 7 points of swapped card sets and *Harder* always has a consistent amount of three maximum available skips. Those both presets have not been included in these respective results either.

### 5.2.2 Surveys

*Easier* was once again preferred by the majority from the surveys. However *Audiovisual* was now the most disliked preset instead of *Harder*. The majority of the participants agreed that *Easier* was fun to play, had the right challenge, was easy to understand. Despite having an easier difficulty, survey results (*see appendix D.2*) shown that the timer remained just as stressful as in other presets.

One-third of the participants stated they were having issues with the "Skip Cards" mechanics, through statistics (*see appendix C.2*) show that half of the participants did not make use of the mechanic at all with one participant stating it was not worth using it.

The majority stated that having too many cards was their biggest issue and that not having enough time was their smaller issue. The use of sound helped a few users to gain a better understanding of how many points card sets were worth and also helped them to stay engaged. Most users found the use of sound appropriate and thus not distracting. Users did in general not have any issues getting to successfully conclude the experiment.

Compared to the previous iteration they have been fewer suggestions to improve the graphics and sound, indicating it had been a distracting factor previously and that in the second iteration users were less bothered by a lack of it, through it was still the most voted suggestion. The suggestion to lower the difficulty and make the gameplay still remains, especially among users who did not use the "Skip Cards" mechanics. 90% of the participants stated they did not get stuck at any point and 80% did the experiment in one go.

### 5.2.3 Interview

An additional interview was conducted, with mostly the same questions and a few additional questions as during the first iteration (*see section 5.1.3*). The interviewed participant had no issue getting started with the experiment. He did not particular care about scoring points and stated it was because he was too focused on playing the game and watching the timer clock which was about to expire instead. Paying too much attention at the time that was remaining affected his performance a bit. He was not under the impression he could get much better at the game, stating while the experiment itself was good that the core concept (memory) was too dated to remain engaging.
The results from the participant led to suggest that without the animated background the dated game would be even more boring. The graphics and audio presentation was not something to reflect upon until the preset *Audiovisual*. Even if the background might have been slightly distracting at first it should remain within the game.

### 5.2.4 Differences

To summarize the second iteration, the preset *Audiovisual* had been perceived worse than before, making it closer to the preset *Harder*. While there was only one participant that was observed and interviewed, it became clear the user had an easier time getting started as he was dealing with fewer menus and buttons, including the removal the login-system. The interviewed participant was more praising of the graphical presentation than from the interviewed participants of the first iteration and was more affected by the preset *Audiovisual* as a result. The surveys support that change as well.

The average participant managed to score more points on an average-per-second, except for the preset *Harder*. This is because the pacing had been sped up to a limit of 2 minutes maximum, meaning that the difficulty rises faster and starts higher. To combat the additional difficulty the "Skip Cards“ mechanics was added. Despite the increased difficulty, the average player still managed to score higher than the participants from the first iteration.

A few of the new participants did not use the "Skip Cards” mechanics which made the game much harder upon them and as a result led them to answer the survey with less favorable answers, meaning they enjoyed it less and had more suggestions and criticisms for improvements. Participants of the first iteration expressed a desire for more concise and visual instructions. This concern had been improved upon in the second iteration but did not had the expected result that would have led users understanding the rules and mechanics of the prototype easier.

### 5.3 Effect of Design Principles

*Section 2.3* introduced several design principles for this study and *section 3* specified which design principles would be implemented in the prototype. The following could be said about the applied design principles from analyzing the results of the study:

- **Feedback**: Has an effect on performance. A lack of feedback led to more mistakes that were made.
- **Momentarily Experience**: Players experienced more pressure leading to stress and frustration due to constantly been required to actively earn points for more time.
- **Immersion**: A poor immersion did not lead to lower scores and playing times, but it might have caused players to not care about making more mistakes.
- **Interface Design**: An inability to properly recognize and distinguish the cards would have led to players making more mistakes, through it did not prevent them from playing the game.
- **Practice**: Players were successful in advancing farther than usual during a brief introduction difficulty. Just ensure that the practice is not too easy and lasts too long that it leads to boredom.
**Pacing:** An easier and slower gameplay led to players waiting a bit too long before a sufficient enough difficulty would kick in. Making it harder and faster however and players did have little time to get adjust to the difficulties.

**Difficulty:** Making it too hard resulted in players almost have no time to experience it, causing stress and frustration. A difficulty that is too easy was better received than one that was too hard, but also quickly led to participants becoming bored during the beginning and later stages of the prototype.

**Choice:** Removing choices led to better performances than expected: points, card swaps, higher timers & playing times. Players might have been less distracted and could focus more on the game itself.

**Reward:** The removal of gaining additional time did not lower the motivation of the participants. Instead it had a positive effect for Static Time. Earning points and advancing to the next round might already be a sufficient enough reward.

**Foreground:** The poor presentation (see section 3.8) led to players playing a bit longer and gaining more score. It also led to making more mistakes. The intact presentation might distract the player leading to worse results. However no one liked the poor presentation.

**Possible Strategies:** Forcing the player on fewer strategies did not lead to a worse performance although while it was less favorable by users. Some statistics were actually increased.

**Relevant Theme:** All users did agree in the survey that stripping the presentation made the game worse. However statistics such as points and played time were increased. Other statistics were worse such as the amount of mistakes made.

It was easier to remain in a state of flow and keep playing the game if the Feedback, Interface Design and Relevant ThemeR were appropriate. An appropriate Difficulty and Pacing led to users making fewer mistakes and to be more focused. Sessions which were easier and longer resulted quicker in players becoming bored while sessions which were harder and shorted resulted quicker in players becoming stressed, which also related to Difficulty and Pacing. Those would have to be the design principles with the largest impact of focus or the state of flow, considering the results and responses from the participants from the prototype experiment.

Earning additional time as the Reward design principle should have served as a motivator, but it did not turn out as expected. Simplifying it kept players performing better. It stopped feeling a reward during Harder and more a necessity for players. It could have felt as a necessity for all other presets as well. Necessity should not be seen as a Reward.

**Possible Strategies** did not lead to an expected outcome as well. Simplification might also have lead to increased performances. Players either did not prefer to make choices in this fast-action puzzle game or it lacked a proper visual description and confused them too much to care about. The interviews described that players did not care about clearing rows faster, just that they could clear out the cards they remembered best.
5.4 Ranking Presets & Design Principles

By comparing the results from each preset from the statistical results (see sections 5.1.1 and 5.2.1) and the surveys (see section D.1 and D.2), the following ranks could be set.

**Presets - First Iteration:**
1. Easier (Difficulty, Practice)
2. Static Time (Less Momentarily Experience, relaxed Pacing)
3. Choices (Less Choices, Less Rewards and Fewer Possible Strategies)
4. Default
5. Audiovisual (Foreground, Relevant Theme, Immersion, Interface Design, Feedback)
6. Harder (Difficulty, Lack of Practice, Momentarily Experience)

**Presets - Second Iteration:**
1. Easier (Difficulty, Practice)
2. Choices (Less Choices, Less Rewards and Fewer Possible Strategies)
3. Static Time (Less Momentarily Experience, relaxed Pacing)
4. Default
5. Audiovisual (Foreground, Relevant Theme, Immersion, Interface Design, Feedback)
6. Harder (Difficulty, Lack of Practice, Momentarily Experience)

The change between both iterations mostly lies between *Choices* and *Static Time*. In the second iteration *Easier* still has the lead but the gap between the second rank is much smaller. The gap between *Harder* and *Audiovisual* is also smaller in the second iteration, implying that *Audiovisual* was seen a bit more negative than before. The overall graphical presentation had been improved while *Audiovisual* still is presented the same in the second iteration. This might have caused users to dislike *Audiovisual* more so since the contrast of the graphical presentation might have been too large. Considering both iterations at once and the ranks would be more similar to that of the second iteration than the first iteration.

Section 5.3 presented the results for the applied design principles and these could be ranked the following in accordance with the ranked presets above. The design principles used in the most favorable presets would be ranked highest, through the design principles used for the least favorable presets should be considered not to lack too much in execution.

**Design Principles:**
1. Difficulty & Practice (Favoring an easier difficulty)
2. Foreground, Relevant Theme, Immersion, Interface Design & Feedback
3. Choice, Reward & Possible Strategies (Favoring less in favor of linear gameplay)
4. Momentarily Experience & Pacing (favoring relaxed)
5. Difficulty, Practice & Momentarily Experience (Favoring a harder difficulty)

Users might have found the preset *Audiovisual* too boring to enjoy, implying it should be important to contain decent and fitting presentation.
6 Discussion

Both presets *Easier* and *Static Time* were among the most well received presets, which both influence the timer. The preset *Easier* made the timer more forgiving while the preset *Static Time* should remove any initial stress by providing “sufficient” time to avoid feeling rushed by it. Since no extra time could be gained there should not be any stress on focusing to gain more so that the player could continue playing for longer. The most common and re-occurring critic for the preset *Harder* was that the timer was too stressing. There was not any indication on any difficulty changes not directly related to the timer (example: starting with more cards) that were troublesome for the user. The less forgiving timer was a cause for their frustration.

The preset *Choices* had the highest ratio for making correct card swaps while the preset *Harder* had the lowest ratio. The preset *Easier* was not far off from the preset *Choices* with it’s ratio value (see figures 13 and 26).

6.1 Game Duration

The preset *Static Time* was designed to last two minutes. Clearing the field causes a reset animation that refreshes the field with new cards and temporary pauses the timer without affecting the playing time during the animation. Performances in the preset *Harder* were less than for the preset *Static Time*. The preset *Default* had a lower performance as well. Both presets *Choices* and *Audiovisual* did not perform badly and managed to stay close to the two minute limit of the preset *Static Time*. Since the preset *Easier* kept ranking the highest during multiple statistics it also kept on going the longest (see figures 16 and 29).

During the first iteration only the preset *Easier* managed to stay above an average of two minutes. This caused concerns as the other presets might have been too difficult. Players might find themselves wasting too much time looking on the clock countdown rather than playing the game. Surveys stated that both presets *Static Time* and *Easier* were seen as the least stressful presets which might indicate that players were too busy dealing with their stress in the other presets and as a result could have caused them to perform worse and making more mistakes.

6.2 Making Mistakes

If each preset would have lasted as long as the preset *Default* (see figures 14 and 27) then the preset *Choices* would have the most correct and the preset *Audiovisual* the most incorrect swapped card sets made by players, where the preset *Easier* has in fact the most correct and incorrect swapped card sets for it’s full duration. Players made more mistakes than correct card set swaps for most presets, even during the preset *Easier*. The preset *Easier* would have had had the fewest correct and incorrect card swaps if it lasted under two minutes. Comparing to the second iteration and the preset *Easier* has now the second place in having the fewest made mistakes. In the second iteration all presets up to maximum of two minutes. The preset *Easier* might have been going on for too long thanks to it’s lower difficulty during the first iteration which led players to making more mistakes by losing their focus at a some point.
The most correct card swaps were made during the presets *Easier* and *Static Time* (see figures 13 and 26). However that does not necessarily mean that both presets were the most engaged by the majority of participants. It could be possible that both presets were performed the best because participants were capable of succession. The higher difficulty of the preset *Harder* that resulted in lower performances could have discouraged users to keep continuing.

### 6.3 Surveys, Observations & Interviews

Most participants from the survey (see appendix D) pointed out that the audiovisual presentation was lacking for the overall game and even more so for the preset *Audiovisual* which along with the preset *Harder* were the least enjoyed presets. The majority preferred the preset *Easier* over the preset *Static Time* indicating that having a lower difficulty where gaining time as a task is more than important than having a predetermined time. The survey is aligned with the result that both presets *Harder* and *Audiovisual* were not preferred. Interestingly, the preset *Choices* was considered by a few users to be more enjoying than the preset *Easier*.

One-third of the users were not stressed by the timer during the preset *Static Time*, which could be because players no longer could earn additional time which forced them to perform as well as they could within the remaining time. This could cause an increasing stress the lower the timer got near the end rather than constantly throughout the whole round.

The four participants which were interviewed were also observed. It could be noticed that each participant took a little bit of time to find their way around to the experiment the first time. Once the experiment was initiated each user took a few moments to observe the interface and read the text before pressing the Continue button to start. Once started each participant lost a few valuable seconds for only their first preset which was indicated by them aimlessly moving around the cursor and watching the screen rather proceeding. That seemed no longer to be an issue once participants managed to swap their first set of cards, through they seemed to swap cards they could remember the easiest rather than to effectively clearing a row.

The interviewed participants were not particular skilled with the concept of Memory, through they were familiar with it. The interviewed participant from the second iteration stated he some trouble understanding the “Skip Cards” mechanic at first. All participants stated in the survey there were initial difficulties with mechanics such as how to clear the field and effectively earn points during the start.

None of the interviewed participants were found to be focusing on clearing the field. Their playstyle did not change noticeable during the preset *Choices* which changed the gameplay slightly. The participant from the second iteration proceeded playing the preset *Choices* just like before, but made use of the “Skip Cards” mechanic more regularly after each field reset. In general participants did increase their intensity and speed when the timer was about to expire. This could suggest that participants tended to move the slowest with the mouse during the start of each preset and when the field filled with new cards.
Since one-third of the users in the second iteration were having issues with the "Skip Cards" mechanic (see section 5.2.2) the interface might require additional improvements. The second iteration contained a lot less text during the opening instructions and for each preset that might have helped users to get to understand the game quicker. Three interviewed participants (see section E) made it clear that they were only sure what to do to a certain degree. During their observation they did not pay too much attention to the information through text and mostly skipped through it. This could suggest that information should be displayed through visual elements instead such as images. The fourth interviewed participant did state the use of an image related to the “Skip Cards” mechanic did help remind him of it.

6.4 Making Choices

The preset Choices performed better than the preset Default for most of the studied statistics, despite having a slightly lower rating. The majority of the participants stated in the survey that the preset Choices was innovative compared to the other presets. Participants also found it easier to understand, which is likely due to the fact that it was no longer a concern which cards you had to clear, just all cards at once. It was likely the preset itself was not that innovative at all, but was considered as such since it was the only preset that changed the rules, translating into a different gameplay style from the other presets. Players did not mind at all that the choice which cards to clear effectively was taken away from them as they just wanted to clear the cards. This could indicate that changing the gameplay once in a while could be crucial.

6.5 User Performances

Both presets Audiovisual and Default contain the same ruleset and difficulty. While the preset Audiovisual was rated lower (see figures 11 and 20) the participants did manage to swap more correct and incorrect card sets and play a bit longer, through they earned slightly fewer points (see figures 12, 21 and 22). However the participants made more mistakes and did not manage to raise the timer as high as compared to the preset Default. This would imply that it took the participants longer to correctly swap card sets in order to keep going. It could be assumed that the players were getting confused where the card pairs were placed because the cards looked more similar to each other. However, participants might also have been able to keep continue further because of that additional difficulty that could have increased their focus.

The preset Audiovisual did not turn out as bad as might have been expected (see figure 12). The preset Harder performed worse in every area than the preset Audiovisual did, implying that a difficulty that is too high leads to a worse experience and engagement than the lack of graphics, animations and audio. However in the second iteration the gap between the presets Audiovisual and Harder was much smaller (see figures 21 and 22), through the preset Harder still remains the worst performer. Participants might have been performing better in the other presets because of the improved graphical presentation that increases their engagement towards it. The preset Audiovisual remains unchanged in it’s presentation and so should the player’s engagement towards it.
6.6 Flow Theory

Section 2.4 described the Flow Theory as "a situation where a user engages himself with an activity and enters into a state of flow" where the challenge should the capabilities of the user (Velikovsky 2014, p. 2). This implies that the following design principles from section 5.3 have a direct association with the Flow Theory: Momentarily Experience, Immersion, Pacing and Difficulty.

Section 5.4 argued that the design principles of Difficulty and Immersion have been the most important in the case of a fast-action puzzle game. Re-iterating upon section 5.3 which resulted in that a poor Immersion could have distracted the players and not care about their performance as they were not attached to playing the game itself. A difficulty that was too high resulted in players not adjusting accordingly to it and a difficulty that was too easy caused players to wait for something interesting to happen. The former case resulted in anxiety and the second case in boredom, both which are indicators to not reach a state of flow accordingly to Velikovsky (2014) as described in section 2.4.

6.7 Skipping Cards

The second iteration had been successful in lowering the stress of users overall where the surveys resulted in higher ratings and fewer negative answers for each played preset (see sections: C.2 and D.2). This should be cause of the faster gameplay speed, higher starting difficulty, additional mechanics to support the players and a maximum time limit of two minutes for each preset.

The "Card Skips" mechanic was a newly introduced mechanic designed to encourage tactical behavior. A few players stated they were having trouble understanding it’s use (see section: D.2) despite visual depictions during the opening and game-play. This would imply that a visual depiction as part of the Interface Design (see section: 2.3) design principle on how to use a mechanic would not suffice. This is where the design principles Practice and Start-Up Screen (see section: 2.3) would be important, meaning a players should get acquainted with using the mechanic in a forced section without any option for failing. This would also cause the user to understand the importance of a new mechanic.

Users which did use the new mechanics reported (see section: D.2) the game became too easy and would have gotten less successful without using it. Players who did not use the mechanics had less success and reported the game was harder than it should have been. Ultimately, players who did make use of the "Skip Cards" mechanic were giving more favorable answers. This could imply players considered the "Skip Cards" to be an essential mechanic of the game in order to guarantee a successful performance which would less to an improved engagement or even an improved enjoyment with the game.
7 Conclusions

The thesis aimed to study how the application of design principles affected the performance of players of a fast-action puzzle game. The research questions focused on the application of design principles on fast-action puzzle games and how their application affects the performance of players, leading to the result of how these tested design principles were ranked (see section 1.4). These research questions have been analyzed, discussed or concluded upon throughout the thesis.

All tested design principles had an effect on how players performed. Several design principles had a larger effect on the performance and engagement of the players, while other design principles had a smaller effect. Changing the rules of the gameplay through these tested design principles could alter the stress of users, the amount of points users managed to obtain, how long users were playing and how users were playing the game. The changes that had the most impact according to the results of this study were related to the graphical presentation and difficulty while the smallest changes were related to how players were rewarded (see section 5.3).

Players were the most successful during the presets Easier, Choices and Static Time and the least successful during the presets Harder and Audiovisual. The preset Audiovisual did not change the rules of the game, yet had lower performances from users. When the gameplay was too difficult the participants performed the worst in most cases. If the gameplay was too easy the participants performed the best in most cases, through this did not necessarily indicate that their experience was optimal as well (see sections 5.1.1 and 5.2.1).

As noted above, players tended to make more mistakes when the difficulty was higher or the playing time went on for too long, but made fewer mistakes if the game did not drag on for too long. At some point players were losing their focus which resulted in making more mistakes. A poor presentation also led to more mistakes that were made and ending with fewer points despite having no changes in the gameplay, which could be because the poor presentation made it harder to recognize elements from the game (see sections 6.2 and 6.5).

Analyzing the results (from gameplay data, surveys, observation and interviews) it was considered that a lower difficulty with a more relaxed pacing and timer was received the best, followed by a proper audiovisual presentation (see sections 5.4 and 7.2).

In particular users tended not to watch the clock that often when there was sufficient time left. It also resulted in a less stressful experience for users. Users did not particularly pay attention on clearing the field, but rather clearing the cards at the moment itself so that the user could keep going on. Difficulty and Immersion were considered important design principles. A poor Immersion would distract users and make them no longer care about the game, resulting in lower performances. A Difficulty that was too high caused too much anxiety while a Difficulty that was too low caused boredom, with both cases resulting in a negative impact on the performance of users (see sections 6.1, 6.3, 6.6 and 7.1).

Specifically the preset Audiovisual received one of the lowest ratings among all presets and was stated by participants not to be preferable. However the performance of a few statistics were on par with the other presets. Furthermore it could be concluded that:

- The preset Harder had a higher impact on performance than the preset Audiovisual.
- The preset Harder performed the worst and was stated as the least enjoyed and most stressful preset.
Most participants did not manage to reach the higher difficulties on the preset *Harder*.

The presets *Easier* and *Static Time* performed the best and were stated as the most enjoyed and least stressful presets.

The preset *Choices* was more engaging in the second iteration, which had improved performances among participants.

Almost everyone managed to reach at least the next difficulty in the preset *Easier*.

### 7.1 Guidelines

Making a fast-action puzzle game too hard pushes players away, as the lower amount of played time during the preset *Harder* was an indication of that.

- Timers would have to be handled carefully. Having a sufficient starting time ensured that the players could earn more additional time than it would take to find the next pair of cards.
- If a game begins difficult with too many cards at once at the field for the player to memorize then they would give up, which prevents them the chance to get into a flow.
- Players were the most effective if the difficulty increased gradually and slowly, which prevented the player from being overwhelmed.
- Players were not effective to memorize all the cards when there were only three seconds before the round began.
- All these combined difficulties at once from there start were a bit too much. Players were more effective when all difficulties were gradually introduced over time.

The preset *Easier* might seem to be better instead. However, participants mentioned it could be boring, especially as it could be observed by the played time which was at least twice as long as the average of the other presets.

- Players often ended up waiting to lose. For most presets a majority of the participants had their timer maxed out, meaning that players could easily gain more additional time than they would need to figure out where the next pair of cards were placed.
- The amount of cards started out with so few that players could easily breeze through them. Almost all participants did manage to at least reach the next difficulty, a much higher percentage than with other presets.
- The increased time of seven seconds to memorize all cards made it even easier, especially during the starting difficulty.
- All combined at once might have made the game a bit too easy, especially at the start.

Participants had an issue with reaching the higher difficulties in the preset *Harder* which had the lowest percentage of all other presets. As a conclusion the prototype should have been a bit more difficult at the start and gradually become harder at a decent pace. A form of additional aid should be included to counter the increased difficulty over time such an option to skip a few cards.
In conclusion the preset *Static Time* was seen as one of the preferable presets. The preset *Static Time* would contain some of the most favorable elements to strive after in designing this fast-action puzzle game. Both the length of the game and the timer had the most potential to affect the player in a negative manner through anxiety or boredom.

- There was a fixed time no matter how skilled one is. All that matters is gaining the highest amount of points within the given time.
- Focusing on time was no longer important since it could not be affected anymore, leaving less things to consider at once which gives fewer opportunities for stress.
- Players were not "punished" to keep playing even longer because they performed well. Because players suggested that the preset *Easier* should have lasted a bit shorter they could have lowered their performance on purpose in order to stop quicker.
- Less skilled players did not have the opportunity to keep going as long as they liked. This could no longer have been a concern during the preset *Static Time* which lasted equally for everyone.

### 7.2 Reflecting Upon Design Principles

*Difficulty* is a design principle that had the most effect especially when turning it too high, although a difficulty that is too low leads to negative effects as well. The design principle *Pacing* should be considered as well as it either could make players get stuck at the beginning or making them bored because it takes too long to get to a more exciting challenge. A lack of excitement can lead to a worse performance, since boredom can cause distraction.

Having a poor presentation was agreed by the users as a negative aspect of the experiment. However users did manage to perform better than expected. It was expected since the preset *Audiovisual* had the worst rating and liked the least in the survey that it also performed the worst in each scenario. This might imply that while a user is aware that poor graphics are a negative part of the design it does not completely prevent them from engaging and performing decently with a fast-action puzzle game.

A proper difficulty relative to the user, the usage of the timer and audiovisual quality have resulted in the three major causes for concern when not done properly. *Static Time* shown that having a fixed amount causes players to feel more at ease while the preset *Harder* resulted in much shorter played time. This traces back to the following design principles: *Momentarily Experience*, *Pacing* and *Difficulty*.

The preset *Audiovisual* traces back to the following design principles: *Feedback*, *Interface Design* and *Foreground*. Users did not mention the lack of *Feedback* in detail which could likely imply that the lack of *Interface Design* and *Foreground* were more concerning to them. *Feedback* might only properly exist within a sufficient graphical environment.
7.3 Background of Participants

The age group and gender of participants were asked in the second iteration. No information of this existed from the first iteration. There has not been any analysis conducted in relation to this study and the background of participants. What is known is that the second iteration ended up with a few more female participants and that most of the participants were in the age group of 25 to 34. A further analysis could not be conducted since it would require a more in depth investigation of the behavior and background of users, which was not the scope of this study. No further implications of the background of users will be made for this study.

Figure 30: Age Group of Participants

Figure 31: Gender of Participants
7.4 Improvements in the Second Iteration

The preset *Choices* had been received more favorable in the second iteration while the preset *Audiovisual* had been received less favorable in the second iteration (see sections 5.1 and 5.2). This had been because more strategic options and a larger presentation (through more sound, music, animations, color and graphics) have been added into the prototype. The ”Skip Cards” mechanic made the fast-action puzzle game more approachable and limiting the maximum time limit to two minutes was considered a favorable change.

The participants had it easier to remember which presets they played, as demonstrated during the surveys and observation, where users previously did more often tend to state that they had already forgotten about a particular preset (see appendixes D.1 and D.2). The presentation of the prototype had been considered to be improved enough so that users could remember the prototype better. Among these improvements were clearer and more concise instructions and reminders for each preset.

The second iteration demonstrated that having an improved or downgraded presentation as part of the *Interface Design* and *Foreground* of a fast-action puzzle game led to a higher difference in performance, which is likely because the engagement of the participant was affected. At the same time the second iteration demonstrated it had a better *Pacing* as well as most participants managed to play the maximum time limit of two minutes. The use of the ”Skip Cards” mechanics managed to keep the game at an accessible *Difficulty*, provided the players utilized that mechanic. This allowed players to play the maximum time limit of two minutes as well and earn a higher score. Players which did not utilize the ”Skip Cards” mechanic had a much harder time with the game.

The results of the study suggested that the design principles *Interface Design, Foreground, Pacing and Difficulty* might saw the largest improvements according to the statistics from the participants. Therefore these four design principles could be more important in the design of a fast-action puzzle game.

7.5 Improvements & Future Study

A prototype was made for the purpose of this study. The time used for the development of the prototype was limited which caused some of the discussed design principles not to be included or only partly. The prototype should be redesigned with additional mechanics and variables to measure in order to specify how design principles can affect an fast-action puzzle game. Raising the difficulty adds more cards on the playing board. Awarded additional time is only slightly affected (such as being rewarded with one second less when clearing rows or columns) on the higher difficulties. The presets *Easier* and *Harder* modify the timer and the preparation time each new round. Since higher difficulties have a focus on adding more cards only the player’s skill to memorize a higher amount of cards could be studied while keeping the same time constraints.
Another method to approach the experiment was to use two timers at once, with one timer that was set at two minutes which could not be increased and a secondary timer that ran at several seconds that could be increased by clearing cards. This would ensure that the whole experiment would not last too long for the participants. However, that would mean it could no longer be tested how long it would require to experience boredom. A few statistics that could be measured were not done so because the prototype lacked an implementation for it due to time constraints, such as measuring how many timer users swapped cards every 15 seconds. This would have helped into making a clear distinction when boredom or anxiety would occur for the user.

The graphics and the use of sound and music might be limited or underwhelming during all presets. Having an improved audiovisual presentation would lead to a larger difference of engagement during the preset Audiovisual when the presentation suddenly becomes absent. This was also a limitation with the limited available development time. The graphical design took a lot longer than expected and required much more time to go through properly than the gameplay design. Proper audiovisual design requires a skill set different from gameplay and framework design which the developer had less expertise with. Instead the programmer had a larger knowledge on gameplay and framework design. An extended prototype would require more than one person for development. A second iteration of the prototype was developed and studied once the study of the first iteration was concluded in order to address several of these issues.

The topic of this study started with discussing the quality of video games. However the thesis would not have been subjective enough and it was instead chosen to study how users would perform within a specific genre. This resulted into the development of a prototype so that player statistics could be measured on how they would perform. The fastest and easiest method was to develop a fast-action puzzle game in JavaScript. A fast and easy development was essential as experience learned that developing projects always took longer and was harder to get to work properly than expected, especially with a time limit which also included research, participation of users, user studies and writing.

Different choices could have been made during development. Some problems could have been identified earlier which would have made development both faster and easier. The development of the prototype had to be concluded eventually in order to continue with the Data Collection method, which means that the limitations and available content have to be dealt with as it is. Creating the prototype took far longer than expected. With a functional framework any subsequent iterations would be faster developed for subsequent studies.

A fast-action puzzle game like Tetris was not made at once either. As this study analyzed, multiple iterations can lead to preferable results for players. A game can only be fully improved through iteration, failure and learning from others (O’Connor 2013), which could lead to improved performances among players. The application of design principles should perhaps be considered just as important for all genres of video games.
References


## A Ranked Results (Highest Values)

### A.1 Iteration 1

#### Table 4: Star Rating

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#### Table 6: Correct Swapped Card Sets

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#### Table 7: Incorrect Swapped Card Sets

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#### Table 8: Ratio Correct / Incorrect Swaps

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#### Table 9: Difficulty Increases

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#### Table 10: Time Left Clock

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#### Table 11: Time Played

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### A.2 Iteration 2

#### Table 12: Star Rating

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#### Table 13: Used Skips

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#### Table 14: Obtained Card Face Value

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#### Table 15: Maximum Available Skips

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#### Table 16: Times Pausing Game

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#### Table 17: Maximal Used All Skips

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#### Table 18: Total Points

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#### Table 19: Correct Swapped Card Sets

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Table 20: Incorrect Swapped Card Sets

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Table 21: Ratio Correct / Failed Swaps

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Table 22: Reached Level

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Table 23: Time Left Short Clock

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Table 24: Time Left 2-Minute Clock

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Table 25: Fields Cleared With Cards

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Table 26: Highest Played Time

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### B Raw Data (Sorted)

#### B.1 Iteration 1

**Table 27: Highest Star Rating**

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**Table 28: Highest Total Points**

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**Table 29: Highest Correct Swapped Card Sets**

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**Table 30: Highest Incorrect Swapped Card Sets**

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Table 31: Highest Ratio Between Correct And Incorrect Swapped Card Sets

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Table 32: Highest Reached Difficulty

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Table 33: Highest Amount Time Left On Clock

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### B.2 Iteration 2

#### Table 35: Highest Star Rating

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#### Table 37: Highest Obtained Card Face for Points

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### Table 43: Highest Ratio Between Correct And Incorrect Swapped Card Sets

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### Table 44: Highest Fields Cleared With Cards

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Table 45: Highest Reached Level

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Table 46: Highest Level Increases

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Table 47: Highest Times Pausing Game

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Table 48: Highest Amount Time Left On Short Clock

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Table 49: Highest Amount Time Left On 2-Minute Clock

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Table 50: Highest Amount Played Time

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</table>
C Raw Data (Per Participant)

C.1 Iteration 1

Description of terms

Rate: The star rating participants gave.
Points: Amount of points gained by correctly swapping a pair of cards.
Correct: Amount of times the participant swapped a pair of cards which did match.
Failed: Amount of times the participant swapped a pair of cards which did not match.
Difficulty: Highest increases of the difficulty level.
Highest Time: Time left on the timer that increased when scoring points.
Total Time: Total time played for the preset.

Table 51: Participant 01

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Table 52: Participant 02

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</table>
C.2 Iteration 2

Description of terms

Rate: The star rating participants gave.

Points: Amount of points gained by correctly swapping a pair of cards.

Face: The pair of cards with the highest amount of points that were swapped that did match.

Skips: Amount of card pairs were that were skipped and could be used in total.

Correct: Amount of times the participant swapped a pair of cards which did match.

Failed: Amount of times the participant swapped a pair of cards which did not match.

Clears: Amount of times a row or column was cleared.

Level: Highest reached difficulty level.

Pauses: Amount of times the participant paused the game.

Short Clock: Time left on the timer that increased when scoring points.

Long Clock: Time left of the 2 minute limit at the conclusion of the preset.

Total: Total time played for the preset.

Table 67: Participant 01

<table>
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<th>Skips</th>
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<th>Failed</th>
<th>Clears</th>
<th>Level</th>
<th>Pauses</th>
<th>Short Clock</th>
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78
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</table>

Table 74: Participant 08

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<th>Level</th>
<th>Pauses</th>
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<td>26</td>
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### Table 75: Participant 09

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<th>Clears</th>
<th>Level</th>
<th>Pauses</th>
<th>Short Clock</th>
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<td>13</td>
<td>13</td>
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<td>0/3</td>
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<td>13</td>
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<td>01:43</td>
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<td>0/4</td>
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<td>3/3</td>
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<td>39</td>
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<td>00:00</td>
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<td>02:07</td>
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<td>5/9</td>
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<td>26</td>
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D  Surveys

D.1  Iteration 1

D.1.1  Survey #1

1 - Which preset did you enjoy the most = Choices
1b - What made that preset better than the other presets = It had the best challenge

2a - Which preset did you enjoy the least = Easier
2b - What made that preset worse than the other presets = It was tedious, It was too simple to enjoy

3 - How difficult did you feel the game was in general = The difficulty was good

4 - Which preset did you had the most trouble playing it = Audiovisual

5 - Which preset did you had the least trouble playing it = Easier

6 - Preset Easier = It did not take too long

7 - Preset Harder = It had the right challenge

8 - Preset Choices = It had the right challenge

10 - Preset Static Time = It did not take too long

11 - Preset Default = It did not take too long

12 - Any suggestions you like to add = It’s difficult to remember all the preset names, that could be made more clear. Other than that I noticed some fatigue after playing many presets, it was a bit tedious.

13 - What would you like to see improved = Make the game play faster

D.1.2  Survey #2

1 - Which preset did you enjoy the most = Choices
1b - What made that preset better than the other presets = I had the most fun playing that

2a - Which preset did you enjoy the least = Audiovisual
2b - What made that preset worse than the other presets = It did not make any difference on how I played it

3 - How difficult did you feel the game was in general = The difficulty was good

4 - Which preset did you had the most trouble playing it = Audiovisual

5 - Which preset did you had the least trouble playing it = Easier

6 - Preset Easier = I had fun playing it, It had the right challenge, It was easy enough to understand, It did not take too long, I was not stressed by the timer
7 - Preset Harder = I had fun playing it, It had the right challenge, It was easy enough to understand, It did not take too long, I was not stressed by the timer

8 - Preset Choices = I had fun playing it, It had the right challenge, It was easy enough to understand, It did not take too long, I was not stressed by the timer

9 - Preset Audiovisual = I had fun playing it, It had the right challenge, It was easy enough to understand, It did not take too long, I was not stressed by the timer

10 - Preset Static Time = I had fun playing it, It had the right challenge, It was easy enough to understand, It did not take too long, I was not stressed by the timer

11 - Preset Default = I had fun playing it, It had the right challenge, It did not take too long, I was not stressed by the timer

12 - Any suggestions you like to add = I missed the sound by the one game where there wasn’t any sound. Also the sound when you made a mistake was a bit bothering me after a while, it repeated to much (maybe because my memory sucked). Otherwise I had very much fun playing it. I enjoyed all the presets.

13 - What would you like to see improved = Improve the graphics, Improve the sound and music

D.1.3 Survey #3

1 - Which preset did you enjoy the most = Easier

1b - What made that preset better than the other presets = It was the easiest to understand

2a - Which preset did you enjoy the least = Harder

2b - What made that preset worse than the other presets = I already had forgotten it

3 - How difficult did you feel the game was in general = The difficulty was good

4 - Which preset did you had the most trouble playing it = Static Time

5 - Which preset did you had the least trouble playing it = Easier

6 - Preset Easier = I had fun playing it

7 - Preset Harder = It did not take too long

8 - Preset Choices = It was innovative

9 - Preset Audiovisual = It did not take too long

10 - Preset Static Time = It had the right challenge

11 - Preset Default = It was easy enough to understand

13 - What would you like to see improved = Improve the sound and music
D.1.4 Survey #4

1 - Which preset did you enjoy the most = Easier
1b - What made that preset better than the other presets = I had the most fun playing that, the timer gave me the least problems
2a - Which preset did you enjoy the least = Default
2b - What made that preset worse than the other presets = I already had forgotten it, I could not recognize the cards
3 - How difficult did you feel the game was in general = The difficulty was good
4 - Which preset did you had the most trouble playing it = Static Time
5 - Which preset did you had the least trouble playing it = Easier
6 - Preset Easier = I had fun playing it, it had the right challenge
7 - Preset Harder = I had fun playing it, it had the right challenge
8 - Preset Choices = I had fun playing it, it had the right challenge
9 - Preset Audiovisual = I could do a task in sufficient many ways
10 - Preset Static Time = I had fun playing it
11 - Preset Default = I had fun playing it, it had the right challenge
12 - Any suggestions you like to add = Bigger cards, a little bit more time.
13 - What would you like to see improved = Improve the graphics, Make the game play slower

D.1.5 Survey #5

1 - Which preset did you enjoy the most = Easier
1b - What made that preset better than the other presets = I had the most fun playing that
2a - Which preset did you enjoy the least = Harder
2b - What made that preset worse than the other presets = It was too stressing, I could not recognize the cards
3 - How difficult did you feel the game was in general = Too difficult
4 - Which preset did you had the most trouble playing it = Choices
5 - Which preset did you had the least trouble playing it = Default
6 - Preset Easier = I had fun playing it
7 - Preset Harder = I was not stressed by the timer
8 - Preset Choices = I had fun playing it
9 - Preset Audiovisual = It had the right challenge
10 - Preset Static Time = I had fun playing it
11 - Preset Default = I was not stressed by the timer
12 - Any suggestions you like to add = I liked the numbers more than the cards, it was easier. The cards could be bigger.
13 - What would you like to see improved = Improve the graphics

D.1.6 Survey #6

1 - Which preset did you enjoy the most = Easier
1b - What made that preset better than the other presets = I had the most fun playing that
2a - Which preset did you enjoy the least = Harder
2b - What made that preset worse than the other presets = It was too stressing
3 - How difficult did you feel the game was in general = A little bit too difficult
4 - Which preset did you had the most trouble playing it = Harder
5 - Which preset did you had the least trouble playing it = Easier
6 - Preset Easier = It was easy enough to understand
7 - Preset Harder = I was not stressed by the timer
8 - Preset Choices = I had fun playing it
9 - Preset Audiovisual = I had fun playing it
10 - Preset Static Time = It did not take too long
11 - Preset Default = It was easy enough to understand
13 - What would you like to see improved = Improve the graphics, Make it less difficult, Make the game play slower

D.1.7 Survey #7

1 - Which preset did you enjoy the most = Static Time
1b - What made that preset better than the other presets = I had the most fun playing that
2a - Which preset did you enjoy the least = Audiovisual
2b - What made that preset worse than the other presets = It was boring
3 - How difficult did you feel the game was in general = The difficulty was good
4 - Which preset did you had the most trouble playing it = Harder
5 - Which preset did you had the least trouble playing it = Easier
6 - Preset Easier = I had fun playing it, I was not stressed by the timer
7 - Preset Harder = I had fun playing it, It had the right challenge
8 - Preset Choices = I had fun playing it
11 - Preset Default = I had fun playing it
12 - Any suggestions you like to add = Add a more appropriate sound when misplays occur. Good user layout, but could improve using more modern looking design.

13 - What would you like to see improved = Improve the graphics, Improve the sound and music

D.1.8 Survey #8

1 - Which preset did you enjoy the most = Easier
1b - What made that preset better than the other presets = I had the most fun playing that
2a - Which preset did you enjoy the least = Harder
2b - What made that preset worse than the other presets = I already had forgotten it
3 - How difficult did you feel the game was in general = The difficulty was good
4 - Which preset did you have the most trouble playing it = Choices
5 - Which preset did you have the least trouble playing it = Easier
6 - Preset Easier = I had fun playing it
7 - Preset Harder = It was easy enough to understand
8 - Preset Choices = I had fun playing it
9 - Preset Audiovisual = I had fun playing it
10 - Preset Static Time = I had fun playing it
11 - Preset Default = I had fun playing it
13 - What would you like to see improved = Improve the graphics

D.1.9 Survey #9

1 - Which preset did you enjoy the most = Easier
1b - What made that preset better than the other presets = I had the most fun playing that, It was the easiest to understand, The timer gave me the least problems
2a - Which preset did you enjoy the least = Harder
2b - What made that preset worse than the other presets = It was too stressing
3 - How difficult did you feel the game was in general = The difficulty was good
4 - Which preset did you have the most trouble playing it = Audiovisual
5 - Which preset did you have the least trouble playing it = Easier
6 - Preset Easier = I had fun playing it, It had the right challenge, It was easy enough to understand, I was not stressed by the timer
7 - Preset Harder = It was easy enough to understand, It did not take too long
8 - Preset Choices = It had the right challenge, It did not take too long
9 - Preset Audiovisual = It did not take too long

10 - Preset Static Time = I had fun playing it, It had the right challenge, It did not take too long, I was not stressed by the timer

11 - Preset Default = I had fun playing it, It had the right challenge, It was easy enough to understand, It did not take too long, I was not stressed by the timer

13 - What would you like to see improved = Improve the graphics, Improve the sound and music, Make the game play faster, Add more tasks to do

D.1.10 Survey #10

1 - Which preset did you enjoy the most = Easier

1b - What made that preset better than the other presets = I had the most fun playing that

2a - Which preset did you enjoy the least = Audiovisual

2b - What made that preset worse than the other presets = It was boring

3 - How difficult did you feel the game was in general = The difficulty was good

4 - Which preset did you had the most trouble playing it = Harder

5 - Which preset did you had the least trouble playing it = Easier

6 - Preset Easier = I had fun playing it, It was innovative, It had the right challenge, It was easy enough to understand, It did not take too long, I was not stressed by the timer

7 - Preset Harder = I had fun playing it, It was innovative, It had the right challenge, It was easy enough to understand, It did not take too long, I was not stressed by the timer

8 - Preset Choices = I had fun playing it, It was innovative, It had the right challenge, It was easy enough to understand, It did not take too long, I was not stressed by the timer

9 - Preset Audiovisual = I had fun playing it, It was innovative, It had the right challenge, It was easy enough to understand, It did not take too long, I was not stressed by the timer

10 - Preset Static Time = I had fun playing it, It was innovative, It had the right challenge, It was easy enough to understand, It did not take too long, I was not stressed by the timer

11 - Preset Default = I had fun playing it, It was innovative, It had the right challenge, It was easy enough to understand, It did not take too long, I was not stressed by the timer

13 - What would you like to see improved = Improve the graphics, Improve the sound and music

D.1.11 Survey #11

1 - Which preset did you enjoy the most = Easier

1b - What made that preset better than the other presets = It was the easiest to understand

2a - Which preset did you enjoy the least = Harder

2b - What made that preset worse than the other presets = It was too stressing
3 - How difficult did you feel the game was in general = The difficulty was good
4 - Which preset did you had the most trouble playing it = Audiovisual
5 - Which preset did you had the least trouble playing it = Easier
6 - Preset Easier = I had fun playing it, It had the right challenge, It was easy enough to understand, It did not take too long
7 - Preset Harder = I had fun playing it, I could do a task in sufficient many ways
8 - Preset Choices = I had fun playing it, It was innovative, It was easy enough to understand, I was not stressed by the timer
9 - Preset Audiovisual = I had fun playing it, It had the right challenge, It did not take too long
10 - Preset Static Time = It had the right challenge, It was easy enough to understand
11 - Preset Default = I had fun playing it, It did not take too long, I was not stressed by the timer
13 - What would you like to see improved = Make it less difficult, Make the game play faster

D.1.12 Survey #12

1 - Which preset did you enjoy the most = Easier
1b - What made that preset better than the other presets = I had the most fun playing that, It was the most innovative, It had the best challenge, It was the easiest to understand, It gave me the most freedom to play it, It had the most optimal duration for me, The timer gave me the least problems
2a - Which preset did you enjoy the least = Audiovisual
2b - What made that preset worse than the other presets = It was boring, It was too stressing, I could not recognize the cards
3 - How difficult did you feel the game was in general = The difficulty was good
4 - Which preset did you had the most trouble playing it = Audiovisual
5 - Which preset did you had the least trouble playing it = Easier
6 - Preset Easier = I had fun playing it, It was innovative, It had the right challenge, It was easy enough to understand, It did not take too long, I was not stressed by the timer
7 - Preset Harder = I had fun playing it, It was innovative, It had the right challenge, It was easy enough to understand, It did not take too long, I was not stressed by the timer
8 - Preset Choices = I had fun playing it, It was innovative, It had the right challenge, It was easy enough to understand, It did not take too long, I was not stressed by the timer
9 - Preset Audiovisual = I had fun playing it, It was innovative, It was easy enough to understand, It did not take too long, I was not stressed by the timer
10 - Preset Static Time = I had fun playing it, It was innovative, It had the right challenge, It was easy enough to understand, It did not take too long, I was not stressed by the timer
11 - Preset Default = I had fun playing it, It was innovative, It had the right challenge, It was easy enough to understand, It did not take too long, I was not stressed by the timer

13 - What would you like to see improved = Improve the graphics, Improve the sound and music
D.2 Iteration 2

Questions A through F were answered during the experiment. Numbered questions were answered afterwards during the survey. Questions 13 and 17 have been masked to protect private information (name and contact info).

D.2.1 Survey #1

1a - Which preset did you enjoy the most = Easier
1b - What made that preset better than the other presets = I had the most fun playing that, It had the best challenge
2a - Which preset did you enjoy the least = Harder
2b - What made that preset worse than the other presets = It was too stressing, The difficulty was misplaced
3 - How difficult did you feel the game was in general = The difficulty was good
4 - What gave you the most problems = Having too many cards
5 - What gave you the fewest problems = Not having enough time

A - Preset Default =
I had fun playing it: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

B - Preset Easier =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

C - Preset Harder =
I had fun playing it: No
It was innovative: No
It had the right challenge: No
It was easy enough to understand: No
I had enough choices to make: No
The playtime was good: Yes
The timer was stressful: No

D - Preset Choices =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

E - Preset Static Time =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

F - Preset Audiovisual =
I had fun playing it: No
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

6 - Did you get stuck at any point = No
7 - Did you retry the experiment = Yes
8 - How much fun did you have playing it = 3: Normal
9 - How did you feel about the Skip Cards mechanic = I used it with strategic use, It made the game too easy
10 - How did you feel about the use of sound = It was appropriate, It made me understand the value of cards, It made me perform better, It kept me alert
11 - Did you try to earn as much points as you could = Yes
12 - What would you like to see improved = Make it less difficult, Make the game play faster
14 - Gender = Male
15 - Age Group = 25-34

D.2.2 Survey #2

1a - Which preset did you enjoy the most = Audiovisual
1b - What made that preset better than the other presets = I had the most fun playing that
2a - Which preset did you enjoy the least = Static Time
2b - What made that preset worse than the other presets = I already had forgotten it
3 - How difficult did you feel the game was in general = The difficulty was good
4 - What gave you the most problems = Clearing a row or column of cards
5 - What gave you the fewest problems = Not having enough time

A - Preset Default =
I had fun playing it: Yes
It was innovative: No
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

B - Preset Easier =
I had fun playing it: Yes
It was innovative: No
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

C - Preset Harder =
I had fun playing it: Yes
It was innovative: No
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: Yes

D - Preset Choices =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: Yes

E - Preset Static Time =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

F - Preset Audiovisual =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

6 - Did you get stuck at any point = Yes
7 - Did you retry the experiment = No
8 - How much fun did you have playing it = 3: Normal
9 - How did you feel about the Skip Cards mechanic = I had trouble understanding how to use it
10 - How did you feel about the use of sound = It kept me alert
11 - Did you try to earn as much points as you could = Yes
12 - What would you like to see improved = Improve the graphics, Improve the sound and music
14 - Gender = Female
15 - Age Group = 25-34

D.2.3 Survey #3

1a - Which preset did you enjoy the most = Easier
1b - What made that preset better than the other presets = I had the most fun playing that, It was the most innovative, It had the best challenge, It was the easiest to understand, It gave me the most freedom to play it, It had the most optimal duration for me, The timer gave me the least problems

2a - Which preset did you enjoy the least = Audiovisual
2b - What made that preset worse than the other presets = It was boring, I already had forgotten it

3 - How difficult did you feel the game was in general = The difficulty was good
4 - What gave you the most problems = Lack of sound, graphics, music and animation
5 - What gave you the fewest problems = Not having enough time

A - Preset Default =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

B - Preset Easier =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

C - Preset Harder =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

D - Preset Choices =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

E - Preset Static Time =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

F - Preset Audiovisual =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

6 - Did you get stuck at any point = No

7 - Did you retry the experiment = No

8 - How much fun did you have playing it = 4: Much

9 - How did you feel about the Skip Cards mechanic = I used it whenever I could, It made the game too easy

10 - How did you feel about the use of sound = It was appropriate

11 - Did you try to earn as much points as you could = Yes

12 - What would you like to see improved = Add more choices to make

14 - Gender = Female
15 - Age Group = 25-34

16 - Any suggestions you like to add = I liked everything about it. The cards were the right size. The music is nice and sounds effects are good as it makes the game more fun. There isn’t much bad to say about.

D.2.4 Survey #4

1a - Which preset did you enjoy the most = Easier

1b - What made that preset better than the other presets = It was the easiest to understand

2a - Which preset did you enjoy the least = Harder

2b - What made that preset worse than the other presets = I already had forgotten it, It was too stressing

3 - How difficult did you feel the game was in general = A little bit too difficult

4 - What gave you the most problems = Having too many cards

5 - What gave you the fewest problems = Not having enough time

A - Preset Default =
I had fun playing it: Yes
It was innovative: No
It had the right challenge: Neutral
It was easy enough to understand: Neutral
I had enough choices to make: Yes
The playtime was good: Neutral
The timer was stressful: No

B - Preset Easier =
I had fun playing it: Neutral
It was innovative: No
It had the right challenge: Neutral
It was easy enough to understand: No
I had enough choices to make: Neutral
The playtime was good: Neutral
The timer was stressful: No

C - Preset Harder =
I had fun playing it: Neutral
It was innovative: No
It had the right challenge: Neutral
It was easy enough to understand: No
I had enough choices to make: Yes
The playtime was good: Neutral
The timer was stressful: Neutral

D - Preset Choices =
I had fun playing it: Neutral
It was innovative: No
It had the right challenge: Neutral
It was easy enough to understand: Neutral
I had enough choices to make: Neutral
The playtime was good: Neutral
The timer was stressful: No

E - Preset Static Time =
I had fun playing it: Neutral
It was innovative: No
It had the right challenge: Neutral
It was easy enough to understand: Neutral
I had enough choices to make: Neutral
The playtime was good: Neutral
The timer was stressful: No

F - Preset Audiovisual =
I had fun playing it: Neutral
It was innovative: No
It had the right challenge: Neutral
It was easy enough to understand: Neutral
I had enough choices to make: Neutral
The playtime was good: Neutral
The timer was stressful: No

6 - Did you get stuck at any point = No
7 - Did you retry the experiment = No
8 - How much fun did you have playing it = 2: Little
9 - How did you feel about the Skip Cards mechanic = I had trouble understanding how to use it
10 - How did you feel about the use of sound = It made me perform better, It kept me alert
11 - Did you try to earn as much points as you could = No, I did not care
12 - What would you like to see improved = Make it less difficult
14 - Gender = Male
15 - Age Group = 45-54
16 - Any suggestions you like to add = Choose easy, medium or hard mode yourself.

D.2.5 Survey #5

1a - Which preset did you enjoy the most = Easier

1b - What made that preset better than the other presets = I had the most fun playing that, It had the best challenge, It was the easiest to understand, It had the most optimal duration for me, The timer gave me the least problems

2a - Which preset did you enjoy the least = Harder

2b - What made that preset worse than the other presets = It was too stressing, The difficulty was misplaced
3 - How difficult did you feel the game was in general = The difficulty was good

4 - What gave you the most problems = Having too many cards

5 - What gave you the fewest problems = Clearing a row or column of cards

A - Preset Default =
I had fun playing it: Yes
It was innovative: Neutral
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Neutral
The playtime was good: Yes
The timer was stressful: Neutral

B - Preset Easier =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

C - Preset Harder =
I had fun playing it: No
It was innovative: Neutral
It had the right challenge: No
It was easy enough to understand: No
I had enough choices to make: Neutral
The playtime was good: Neutral
The timer was stressful: Yes

D - Preset Choices =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

E - Preset Static Time =
I had fun playing it: Yes
It was innovative: Neutral
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

F - Preset Audiovisual =
I had fun playing it: Yes
It was innovative: No
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Neutral
The playtime was good: Yes
The timer was stressful: No

6 - Did you get stuck at any point = No
7 - Did you retry the experiment = No
8 - How much fun did you have playing it = 3: Normal
9 - How did you feel about the Skip Cards mechanic = I used it whenever I could, I used it with strategic use
10 - How did you feel about the use of sound = It was appropriate, It made me understood the value of cards, It made me perform better, It kept me alert
11 - Did you try to earn as much points as you could = Yes
12 - What would you like to see improved = Make the game play faster
14 - Gender = Female
15 - Age Group = 25-34

D.2.6 Survey #6

1a - Which preset did you enjoy the most = Easier
1b - What made that preset better than the other presets = I had the most fun playing that, It had the most optimal duration for me, The timer gave me the least problems

2a - Which preset did you enjoy the least = Audiovisual
2b - What made that preset worse than the other presets = I already had forgotten it, It was too stressing, I could not recognize the cards

3 - How difficult did you feel the game was in general = The difficulty was good

4 - What gave you the most problems = Having too many cards

5 - What gave you the fewest problems = Lack of graphics, sound, music and animation

A - Preset Default =
I had fun playing it: Yes
It was innovative: Neutral
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

B - Preset Easier =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

C - Preset Harder =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

D - Preset Choices =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Neutral
The playtime was good: Yes
The timer was stressful: Neutral

E - Preset Static Time =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: Neutral

F - Preset Audiovisual =
I had fun playing it: Neutral
It was innovative: Yes
It had the right challenge: No
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Neutral
The timer was stressful: Yes

6 - Did you get stuck at any point = No
7 - Did you retry the experiment = No
8 - How much fun did you have playing it = 3: Normal
9 - How did you feel about the Skip Cards mechanic = I used it whenever I could, I used it with strategic use
10 - How did you feel about the use of sound = It was appropriate
11 - Did you try to earn as much points as you could = Yes
12 - What would you like to see improved = Improve the graphics
14 - Gender = Male
15 - Age Group = 35-44

D.2.7 Survey #7

1a - Which preset did you enjoy the most = Easier
1b - What made that preset better than the other presets = It was the easiest to understand
2a - Which preset did you enjoy the least = Easier
2b - What made that preset worse than the other presets = I already had forgotten it
3 - How difficult did you feel the game was in general = Too difficult
4 - What gave you the most problems = Having too many cards
5 - What gave you the fewest problems = Not being able to skip often enough

A - Preset Default =
I had fun playing it: Neutral
It was innovative: Neutral
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Neutral
The playtime was good: No
The timer was stressful: Yes

B - Preset Easier =
I had fun playing it: Neutral
It was innovative: Neutral
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Neutral
The timer was stressful: Yes

C - Preset Harder =
I had fun playing it: Neutral
It was innovative: Neutral
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: No
The timer was stressful: Yes

D - Preset Choices =
I had fun playing it: No
It was innovative: No
It had the right challenge: Neutral
It was easy enough to understand: Yes
I had enough choices to make: Neutral
The playtime was good: No
The timer was stressful: Yes

_E - Preset Static Time_ =
I had fun playing it: Neutral
It was innovative: Neutral
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: No
The timer was stressful: Yes

_F - Preset Audiovisual_ =
I had fun playing it: Neutral
It was innovative: Neutral
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: No
The timer was stressful: Yes

6 - _Did you get stuck at any point_ = No
7 - _Did you retry the experiment_ = No
8 - _How much fun did you have playing it_ = 3: Normal
9 - _How did you feel about the Skip Cards mechanic_ = I had trouble understanding how to use it
10 - _How did you feel about the use of sound_ = It was appropriate
11 - _Did you try to earn as much points as you could_ = No, I did not care
12 - _What would you like to see improved_ = Make it less difficult
14 - _Gender_ = Male
15 - _Age Group_ = 65-74

**D.2.8 Survey #8**

1a - _Which preset did you enjoy the most_ = Easier

1b - _What made that preset better than the other presets_ = I had the most fun playing that, It gave me the most freedom to play it, It had the most optimal duration for me

2a - _Which preset did you enjoy the least_ = Audiovisual

2b - _What made that preset worse than the other presets_ = It did not make any difference on how I played it

3 - _How difficult did you feel the game was in general_ = The difficulty was good

4 - _What gave you the most problems_ = Not having enough time

5 - _What gave you the fewest problems_ = Not having enough time
A - Preset Default =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Neutral
The timer was stressful: Neutral

B - Preset Easier =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: Neutral

C - Preset Harder =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Neutral
The playtime was good: Neutral
The timer was stressful: Neutral

D - Preset Choices =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Neutral
The playtime was good: Neutral
The timer was stressful: Neutral

E - Preset Static Time =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Neutral
It was easy enough to understand: Yes
I had enough choices to make: Neutral
The playtime was good: Neutral
The timer was stressful: Neutral

F - Preset Audiovisual =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Neutral
I had enough choices to make: Neutral
The playtime was good: Neutral
The timer was stressful: Neutral
6 - Did you get stuck at any point = No
7 - Did you retry the experiment = Yes
8 - How much fun did you have playing it = 4: Much
9 - How did you feel about the Skip Cards mechanic = I used it with strategic use
10 - How did you feel about the use of sound = It kept me alert
11 - Did you try to earn as much points as you could = Yes
12 - What would you like to see improved = Make a version for older people
14 - Gender = Female
15 - Age Group = 65-74

D.2.9 Survey #9

1a - Which preset did you enjoy the most = Easier
1b - What made that preset better than the other presets = I had the most fun playing that
2a - Which preset did you enjoy the least = Audiovisual
2b - What made that preset worse than the other presets = It was boring
3 - How difficult did you feel the game was in general = The difficulty was good
4 - What gave you the most problems = Not having enough time
5 - What gave you the fewest problems = Having too many cards

A - Preset Default =
I had fun playing it: Yes
It was innovative: Neutral
It had the right challenge: Neutral
It was easy enough to understand: No
I had enough choices to make: Yes
The playtime was good: No
The timer was stressful: Neutral

B - Preset Easier =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Neutral
It was easy enough to understand: No
I had enough choices to make: Yes
The playtime was good: Neutral
The timer was stressful: Neutral

C - Preset Harder =
I had fun playing it: Neutral
It was innovative: Neutral
It had the right challenge: Neutral
It was easy enough to understand: No
I had enough choices to make: Yes
The playtime was good: Neutral
The timer was stressful: Neutral

D - Preset Choices =
I had fun playing it: Yes
It was innovative: Neutral
It had the right challenge: Neutral
It was easy enough to understand: No
I had enough choices to make: Yes
The playtime was good: No
The timer was stressful: Neutral

E - Preset Static Time =
I had fun playing it: Yes
It was innovative: Neutral
It had the right challenge: Neutral
It was easy enough to understand: No
I had enough choices to make: Yes
The playtime was good: No
The timer was stressful: Neutral

F - Preset Audiovisual =
I had fun playing it: No
It was innovative: No
It had the right challenge: No
It was easy enough to understand: No
I had enough choices to make: Yes
The playtime was good: No
The timer was stressful: Neutral

6 - Did you get stuck at any point = No
7 - Did you retry the experiment = No
8 - How much fun did you have playing it = 3: Normal
9 - How did you feel about the Skip Cards mechanic = It was not worth using
10 - How did you feel about the use of sound = It made me perform better
11 - Did you try to earn as much points as you could = Yes
12 - What would you like to see improved = Improve the graphics
14 - Gender = Female
15 - Age Group = 45-54
D.2.10 Survey #10

1a - Which preset did you enjoy the most = Choices

1b - What made that preset better than the other presets = I had the most fun playing that, It was the most innovative, It had the best challenge, It gave me the most freedom to play it, The timer gave me the least problems

2a - Which preset did you enjoy the least = Audiovisual

2b - What made that preset worse than the other presets = It was tedious, It was boring, I already had forgotten it, It was too simple to enjoy

3 - How difficult did you feel the game was in general = The difficulty was good

4 - What gave you the most problems = Having too many cards

5 - What gave you the fewest problems = Not being able to skip often enough

A - Preset Default =
I had fun playing it: Yes
It was innovative: Neutral
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

B - Preset Easier =
I had fun playing it: Yes
It was innovative: Neutral
It had the right challenge: Neutral
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

C - Preset Harder =
I had fun playing it: Neutral
It was innovative: Neutral
It had the right challenge: No
It was easy enough to understand: Yes
I had enough choices to make: Neutral
The playtime was good: Neutral
The timer was stressful: Yes

D - Preset Choices =
I had fun playing it: Yes
It was innovative: Yes
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No
E - Preset Static Time =
I had fun playing it: Yes
It was innovative: Neutral
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Yes
The timer was stressful: No

F - Preset Audiovisual =
I had fun playing it: No
It was innovative: No
It had the right challenge: Yes
It was easy enough to understand: Yes
I had enough choices to make: Yes
The playtime was good: Neutral
The timer was stressful: No

6 - Did you get stuck at any point = No
7 - Did you retry the experiment = No
8 - How much fun did you have playing it = 4: Much
9 - How did you feel about the Skip Cards mechanic = I used it with strategic use, It made the game too easy
10 - How did you feel about the use of sound = It was appropriate, It made me understood the value of cards, It made me perform better, It kept me alert
11 - Did you try to earn as much points as you could = Yes
12 - What would you like to see improved = Make the game play faster
14 - Gender = Female
15 - Age Group = 18-24
E Interviews

Three participants have been interviewed to describe their experiences with the prototype. One of the goals with the interviews was to rule out the possibility if participants were having issues with the experiment, preventing them from playing the game as intended by the developer.

Questions already asked in the survey were avoided since those were already answered, unless it adds a new perspective otherwise not known yet.

Only the main questions have been used as titles. Each main question was asked further upon accordingly to what the user might had to add.

E.1 Iteration 1

E.1.1 Interview #1

Q: Have you played Memory before? Are you experienced?
A: Yes, I played Memory since I was young. But I would not say being experienced.

Q: Are you knowledgeable / an expert with games and computers?
A: I am familiar enough with systems that I know my way around, but I do not consider myself an expert. I did play a lot of board games when I was younger.

Q: Did you experience any issues getting started with the experiment on your own?
A: No, I did not experience any issues getting started.

Q: When the experiment first started, was it immediately clear what to do?
A: It went a bit too fast at the very beginning, but quickly afterwards I understood the concept and could continue with relative ease.

Q: Did you at any point wanted to retry because you felt you performed bad?
A: Yes, it did not go that very well my first time. So I wanted to retry it from the start so I could do better for myself. Once I saw it once earlier, it could do the re-attempt with trouble.

Q: Would you have liked to pause the experiment at some time to continue later?
A: No, I did wanted to do everything in one go.

Q: Did you know that the face of each card earns an equal amount of points?
A: I was not actively considering but, but it did make sense now I think about it. I was rather focused on playing the game itself, which took quite some focus.

Q: Was it clear how to clear a field of cards? If not, did it hinder your progress?
A: I did not know that would happen, but it felt naturally that the game would continue this way because it is natural for Memory.

Q: Did you focus on clearing rows or earning points? Were you actively pursuing it?
A: I was focused on clearing rows. And I try my best to do so.

Q: Did you at any point gave up on purpose? Why? Boredom? Anxiety?
A: No, I did not lose on purpose by letting the timer run it. Perhaps I would have done so if it took too long.
Q: Were you content with the amount of earned points and time played?
A: I am often fairly quickly content with my performance in general. That is just how I am. There is not any use about wondering if I could play my games better.

Q: Would you agree you would have been able to perform even better?
A: Yes. I think I could have performed even better. My focus and concentration could have been better. Since the experiment was new too, I think I could have done it much better if I did it a second time now that I know how the game works.

Q: Do you agree you could have given faster input and your memorization could be better?
A: I consider myself to be fairly quick with the mouse, so that would not improve much.

Q: Did you lose focus at any point? Why? It took too long? Too much stress?
A: I did lose my focus several times because the game got stressing because I could not remember the position of the cards exactly.

Q: How much differently did you experience your best and worst chosen preset?
A: Audiovisual was just boring because it has no sound and it is just numbers representing cards. The other presets were fine. Choices was not that much better or worse than the remaining presets, but that at moment I just went with choices. I do not actually remember why I specifically chose that one. I just happen to remember Audiovisual that well since it was by far the most boring.

Q: How stressed were you by the counting timer? Did it get worse the lower it got?
A: Not really. I just wanted to push as many more points I could get with the time that was left. I do not see it as stress, but rather a final push to up my score.

Q: Did you have fun playing the experiment in the end?
A: It was fun. I am quite fond of playing card games. It is my cup of tea.

Q: Did you at any point stop during gameplay to reflect what could be improved?
A: While playing the game I did the feeling sometimes some things were lacking, such as the lacking music or the images were glitchly, but it did not diminish my focus to keep playing onward.

Q: What in your opinion was missing from the game that could made it more fun?
A: I would preferred to have been a better graphical presentation. Mostly the images. Numbers are incredibly boring. Animals or countries or buildings or nature would have been nice.

E.1.2 Interview #2

Q: Have you played Memory before? Are you experienced?
A: Yes, I played Memory and other different types before but not anything like the experiment before.

Q: Are you knowledgeable / an expert with games and computers?
A: I consider myself to be average. If I were to play any new game I would likely be able to figure out what to do without a lot of trouble.
Q: Did you experience any issues getting started with the experiment on your own?
A: I did not encounter any bugs and I did understand the game pretty quickly. I did not get stuck at any point. Creating a new account worked fine and the instructions were clear enough. I played it using Google Chrome.

Q: When the experiment first started, was it immediately clear what to do?
A: I read the instructions first slowly and afterwards it was pretty clear what I had to do. I read the instructions of every preset each time.

Q: Did you at any point wanted to retry because you felt you performed bad?
A: Even if the rules were not that hard, you will learn to understand them better over time. If you play more you will become better and concentrate better. But I did not feel my performance was that bad to start over.

Q: Would you have liked to pause the experiment at some time to continue later?
A: No, I wanted to continue the whole experiment in one session. I was aware the game has the option to be paused or stopped and could be resumed at a later time.

Q: Did you know that the face of each card earns an equal amount of points?
A: Yes, I was aware of that.

Q: Was it clear how to clear a field of cards? If not, did it hinder your progress?
A: Yes, that was clear enough for me from the start.

Q: Did you focus on clearing rows or earning points? Were you actively pursuing it?
A: I put my focus on clearing the cards rather than watching the points. I watched only a little on the points. Time kept ticking on and you want to find as many cards as possible that match. I can not multitask that well. Only at the end of each round did I notice my points. I did not focus that much on numbers.

Q: Did you at any point gave up on purpose? Why? Boredom? Anxiety?
A: No I did not lose on purpose. The game was fine enough. It did not suffer from being too long. Each preset did some new things, so that was a bit refreshing.

Q: Were you content with the amount of earned points and time played?
A: Yes, I was content with the amount of points I had, through I would have liked to gain more if I could. The points itself were not important, just that I could play well, which I think I did.

Q: Would you agree you would have been able to perform even better?
A: I could always have performed even better, especially during the beginning. I was not really sure how seriously to take the experiment, so I might have been more relaxed about my performance.

Q: Do you agree you could have given faster input and your memorization could be better?
A: My memory could have been better, which is definitely improvable. I do not think that my skill with handling the mouse would need to be better, just my memorization a little bit.

Q: Did you lose focus at any point? Why? It took too long? Too much stress?
A: I did not had any issues with losing my focus. I do not think I started making more mistakes than usual, at least not that I recall.
Q: How much differently did you experience your best and worst chosen preset?
A: I would say not that big. To be honestly, I was not playing Harder that long since it was over too fast because I probably was not that good at it.

Q: How stressed were you by the counting timer? Did it get worse the lower it got?
A: I am easily stressed by nature, especially by time. A counting clock was not exactly calming for me and yes it did worse the lower it got because you want to performance as well as you can within the remaining time.

Q: Did you have fun playing the experiment in the end?
A: Yes, I found it very fun to play. It was quite unique in the way you usually do not score points in a Memory Game. This was a single-player version of Memory against yourself, so you do not compare yourself against another who got the most correct. There were also some new rules that made things different and fun.

Q: Did you at any point stop during gameplay to reflect what could be improved?
A: I had some trouble reminding which cards were which since they looked quite similar which made it tricky sometimes to play.

Q: What in your opinion was missing from the game that could made it more fun?
A: I would have preferred cards that looked more different from each other and a different sound effect when picking the wrong card. Other than that I have nothing else to add. The game was fun.

E.1.3 Interview #3

Q: Have you played Memory before? Are you experienced?
A: I am familiar with the game Memory, but I do not play it that often, almost never nowadays.

Q: Are you knowledgeable / an expert with games and computers?
A: I do not really know. At least I do know how to operate on a computer. I am not much of a diverse gamer, but I do play games at times. Mostly digital games.

Q: Did you experience any issues getting started with the experiment on your own?
A: I think it went fine. At least I managed to go through with this experiment, or so I hope. At least the web page did not show me any errors and I did not have much trouble figuring out how to get started playing.

Q: When the experiment first started, was it immediately clear what to do?
A: Yes, I think so. And that which was unclear I pretty much figured out once I started clicking the cards. It is pretty much straight forward from there.

Q: Did you at any point wanted to retry because you felt you performed bad?
A: No. I might have performed a bit better with a short introduction before starting the test, but I think I did it OK.

Q: Would you have liked to pause the experiment at some time to continue later?
A: Not really. It was fine and short enough to do it all at once.

Q: Did you know that the face of each card earns an equal amount of points?
A: Yes. It was quite obvious and clear, except that I did not pay too much attention to it. I had a busier time swapping those cards.
Q: Was it clear how to clear a field of cards? If not, did it hinder your progress?
A: I first started clearing cards everywhere I saw and then I did notice that clearing a row cleared the screen. It did let the game continue.

Q: Did you focus on clearing rows or earning points? Were you actively pursuing it?
A: Neither actually. I was mostly focusing on clearing cards where I noticed them. Points and clearing rows would follow naturally after.

Q: Did you at any point gave up on purpose? Why? Boredom? Anxiety?
A: Why should I? I do not really know if I consider it doing on purpose, but sometimes there timer stressed me too much that I could not remember what to do next.

Q: Were you content with the amount of earned points and time played?
A: I think I am. I do not really know how much I must have earned to be considered content. It is useful for letting me know when I beat my previous records, in which case I can be content.

Q: Would you agree you would have been able to perform even better?
A: Of course I could have done better. I think I have been wasting a bit too much time at the start. I should not make that mistake twice.

Q: Do you agree you could have given faster input and your memorization could be better?
A: I do not know. Could I have done any better? At the moment itself I felt I did what I could. It is easy to look at it back and say what could be better. It does not really matter to me.

Q: Did you lose focus at any point? Why? It took too long? Too much stress?
A: Yes. Mostly when the timer started running a bit too low. A bit too much stress for me.

Q: How much differently did you experience your best and worst chosen preset?
A: All of the presets except for that Audiovisual one are quite ok. That one just become to boring soon. The game being a lot harder was ok, a bit too hard in my opinion. Other than that, they did not matter that much to compare as they are mostly about equal. As long it is pretty to look at and not too hard I am good.

Q: How stressed were you by the counting timer? Did it get worse the lower it got?
A: The counting timer got me a bit stressed when being harder, but other than that the timer did not really rush me. I was too forced on earning time in such a short period, it was a bit too much.

Q: Did you have fun playing the experiment in the end?
A: Yes, it was fun to play. It is like Memory but a bit differently. Except when the timer was going too fast.

Q: Did you at any point stop during gameplay to reflect what could be improved?
A: I mostly thought that the graphics and sound could be improved. Nothing too distracting, but it felt a bit bland at times.

Q: What in your opinion was missing from the game that could made it more fun?
A: The graphics and sound as I said. I would also like to see a version without a timer. Or at least give me enough time to play around with the game. When it was harder it was over before I knew it.
E.2 Iteration 2

E.2.1 Interview #1

Q: Have you played Memory before? Are you experienced?
A: Sure, I have played it a few times. I am mostly casual familiar with it. It is not the most exciting of games.

Q: Are you knowledgeable / an expert with games and computers?
A: I suppose I am. I mostly use mobile devices.

Q: Did you experience any issues getting started with the experiment on your own?
A: I did not think so. I did not think it took that long to get started with it.

Q: When the experiment first started, was it immediately clear what to do?
A: In some way, yes. I was supposed to click the cards and match them. That concept is fairly known.

Q: Was it clear how to skip cards? How should it be better presented?
A: I think I missed a few turns without. I was not really paying that much attention. Through there was a reminder shown on the top of the screen. I would not be sure how to make it clearer. I just was playing much attention as I said.

Q: Did you at any point wanted to retry because you felt you performed bad?
A: No. Why should I. Would that not affect your project?

Q: Would you have liked to pause the experiment at some time to continue later?
A: I did not last that long. Give or take 10 minutes. I can spare that.

Q: Did you know that the face of each card earns an equal amount of points?
A: I did notice that the cards had numbers associated with them, but I did not pay much attention to the points it gave. But yeah, I did make sense how much points they would be worth. The card deck is easy to recognize.

Q: Was it clear how to clear a field of cards? If not, did it hinder your progress?
A: I mostly focused on matching the cards. Sooner or later the field was loaded with new cards again. I figured out that emptying a line did reload the cards again, but that was not really my goal. I was just trying to match cards.

Q: Did you focus on clearing fields or earning points? Were you actively pursuing it?
A: I did not really pay any attention to. My focus was already on the cards themselves and making sure the timer would not run out.

Q: Did you at any point gave up on purpose? Why? Boredom? Anxiety?
A: Just keep going as long as I can. It did not last that long per round either. Perhaps during the last few seconds I might have given up because I did not how to continue from there. I could not find the matching cards to keep going on longer.

Q: Were you content with the amount of earned points and time played?
A: Sure. Why not. It is as it is.

Q: Would you agree you would have been able to perform even better?
A: I think so. You just need to practice a bit and know how it works. But I think the general concept of memory is just not that exciting enough to want to improve myself much further.
Q: Do you agree you could have given faster input and your memorization could be better?
A: With some practice I might. But I am not really sure of that. I felt like I was doing my best at the moment.

Q: Did you lose focus at any point? Why? It took too long? Too much stress?
A: Not for the game itself, through I was not paying any attention to the text or icons. The timer got a bit stressing near the end, so I was a bit lost what to do next since I got too focused on the timer instead.

Q: Was the background distracting? How did it make you perform? Should it exist?
A: I do not really know. It was nice to look at. When it got removed it made the game a bit too boring and bland. But pretty fast you start to ignore it and just focus on the game, but once it was removed it got a bit distracted why the game was suddenly so silent and simple.

Q: How much differently did you experience your best and worst chosen preset?
A: I would say the one where the timer was set to 2 minutes or the one which was easier were the best since I had not that much stress. The one where it got harder really got too hard. But the one that removed the sound and background became boring.

Q: How stressed were you by the counting timer? Did it get worse the lower it got?
A: A bit. At some point I started looking more at the timer rather than clicking on cards. Once I start doing that I would not be able to recover from that, and just lose that round.

Q: Did you have fun playing the experiment in the end?
A: I think I did. It was certainly interesting.

Q: Did you at any point stop during gameplay to reflect what could be improved?
A: Perhaps during that round where there was no sound or background. It made be realize how boring it became without it.

Q: What in your opinion was missing from the game that could made it more fun?
A: I would have loved to use that skip function right from the start, but that is a bit my own fault. I should have read the instructions. At least I did notice that icon during the game. The game was really fine. You can not make memory more fun that this. It is a dated game.
F Source Code

The source code for the first and second iterations prototype can be accessed with the following download links:

— Iteration 1 —
https://1me205.lnu.se/~rh222ff/courses/mediathesis/sourcecode.zip

— Iteration 2 —
https://1me205.lnu.se/~rh222ff/courses/mediathesis_v2/sourcecode.zip

F.1 Iteration 1

Certain parts of the code have been left out to anonymize private data. These changes include:

- Database Server Connection
- Email Address for notifying and reporting database entries
- Email Address for delivering the results of the survey
- URL for the welcoming message for new registered users

The code file init.php had been modified to exclude private information. This file is used to initialize and setup the database with a MySQL server and the email-address used for the reply-system. The file can be found within the folder: /src/php/. Other parts of the code might or might not require to be adjusted to get it fully working.

F.2 Iteration 2

Since user accounts no longer exist the code no longer has to be modified to make them functional again.

The code file database.php now contains the required initialization of the database with a MySQL server and has to be configurated to make it functional again. The HTML page survey.html has the response email address left out for the mail delivery system.
F.3 Credits

Credits for used resources are included with the source code and within this section.

— Graphics —
https://code.google.com/archive/p/vector-playing-cards/
brick (Public Domain)

Robert Willem Hallink (self-made)
brick_outdated & clock

— Music —
http://freemusicarchive.org/music/State_Shirt/This_Is_Old/04_Computer
Computer.mp3

http://freemusicarchive.org/music/Loyalty_Freak_Music/ROBOT_DANCE_/Loyalty_Freak_Music_-_ROBOT_DANCE_-_04_It_feels_good_to_be_alive_too
ItFeelsGoodToBeAlive.mp3

MariachiBanditsOfGatlingGunRidge.mp3

http://freemusicarchive.org/music/Ghost_Hunter/In_The_Early_Months/03_ghost_hunter_-_old_white_eye
OldWhiteEye.mp3

http://freemusicarchive.org/music/Jahzzar/Travellers_Guide/Siesta
Siesta.mp3

— Sound —
https://freesound.org/people/JapanYoshiTheGamer/sounds/423219/
badSet1.wav

Game Maker 8 (2009)
badSet2.wav

Game Maker 8 (2009)
badSetHighValue.wav

https://freesound.org/people/phmiller42/sounds/124996/
badSet.wav

Game Maker 7 (2007)
click.wav

https://freesound.org/people/SailorErick/sounds/430769/
completeRow.wav

https://freesound.org/people/Mudkip2016/sounds/423930/
goodSet.wav

Game Maker 8 (2009)
goodSetHighValue.wav

Game Maker 8 (2009)
goodSetJoker.wav

https://freesound.org/people/maphill/sounds/204103/
ready.wav
https://freesound.org/people/creeeeak/sounds/437322/
refill.wav

Game Maker 8 (2009)
skip.wav

https://freesound.org/people/dersuperanton/sounds/434476/
swap.wav

https://freesound.org/people/InspectorJ/sounds/370195/
timerOver.wav
G  Project Hosting Site

The experiment project can be accessed through the following URL:

— Iteration 1 —
https://1me205.lnu.se/~rh222ff/courses/mediathesis/index.php

— Iteration 2 —
https://1me205.lnu.se/~rh222ff/courses/mediathesis_v2/index.html