

# EXPLORING THE RELATIONSHIPS BETWEEN GAME-MODES, PLAYER SCORE AND PLAYER EXPERIENCE

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CS6350 EMPIRICAL RESEARCH METHODS

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## **EXECUTIVE SUMMARY**

There is a gamer in all of us; the rapid emergence of games in which the play is based on the element of social interaction between players i.e., social games, have given rise to the casual gamer. One of the interesting features in Social Games is that they accommodate the player's schedule. The design solution which enables them to participate at their suitable time is termed as Asynchronous gameplay. The goal of our experiment was to evaluate a player's score and performance in a single player mode versus an asynchronous competitive multiplayer mode. The results could indicate better understanding of the behavior of players and how it could benefit game developers and designers of Social games.

**Keywords:** Social Games, Player Modes, Asynchronous competitive Gameplay, Player Experience, Player Score.

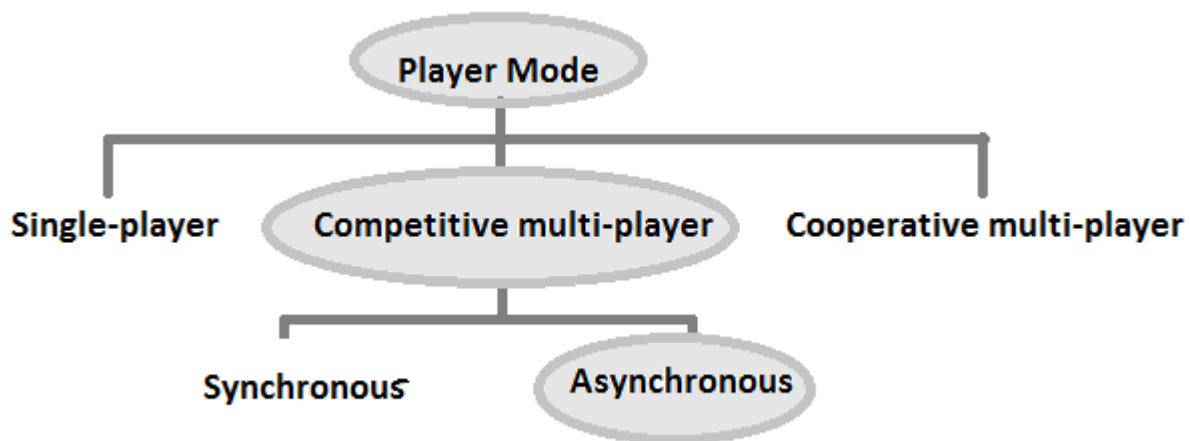
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## 1. AIMS

The research aims at evaluating player performance and player experience when casual games are played on different player modes. We are using the player score as a metric to determine the player performance <sup>[1]</sup>. Player modes can be broadly classified into single player, cooperative multiplayer and competitive multiplayer <sup>[2]</sup>. Furthermore, Multiplayer competitive modes could be classified into Synchronous multi-play and Asynchronous multi-play <sup>[3]</sup>. "Social games" or casual games played over social networks are premised on this Asynchronous multiplayer. For the purpose of our research which revolves around casual games, we are considering single player mode and asynchronous competitive multiplayer mode illustrated in figure 1.1.



**FIGURE 1.1: The classification of Game modes for the purpose of this experiment.**

The following are the hypotheses being evaluated:

**[H1]** An asynchronous competitive multiplayer element in casual games increases player score. Scores of players are affected by the player mode chosen.

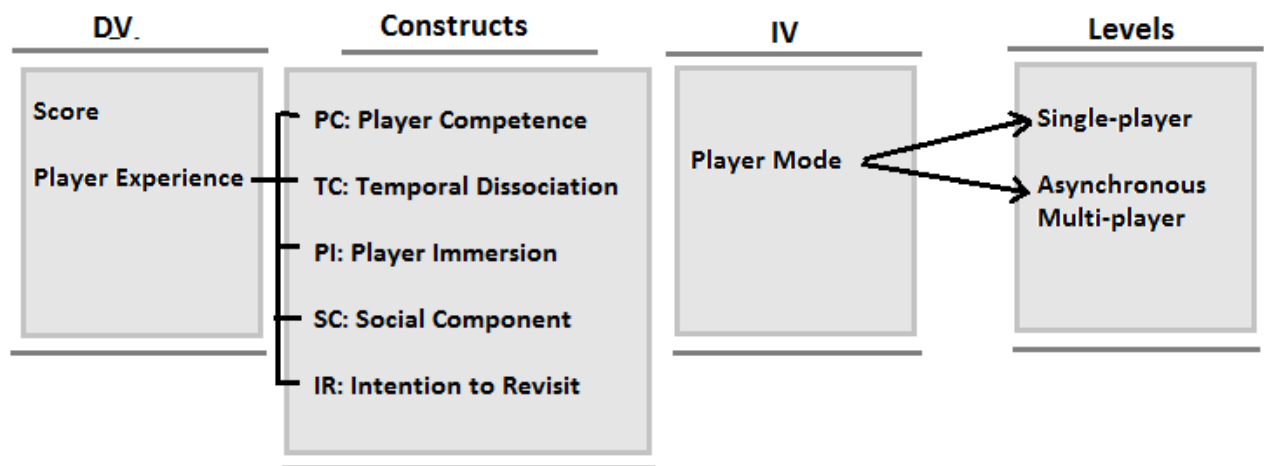
**[H0]** An asynchronous competitive multiplayer element in casual games does not increase player score. Scores of players are not affected by the player mode chosen.

**[H2]** An asynchronous competitive multiplayer element in casual games improves player experience. Player experience is influenced by the player mode chosen.

**[H0]** An asynchronous competitive multiplayer element in casual games does not improve player experience. Player experience is not influenced by the player mode chosen.

We measure player performance and player experience by conducting a repeated measures design based experimental setup for the purpose of data collection. Data is later analyzed using parametric statistical methods.

The Player Mode is the independent variable (IV), and the player score and player experience are the dependent variables (DV). These can be observed from figure 1.2 and they are explained in-depth in section 4.2.



**FIGURE 1.2:** Lists the Relationship between The independent and the dependent variable and the associated constructs and levels within them.

## **2. BACKGROUND AND RELATED WORK**

### **2.1 Of Social gaming, Multiplayer and Asynchronous Multiplay**

According to a recent survey of US and UK gamers, nearly 120 million people are now playing social games weekly, a 71% increase from 2010 <sup>[4]</sup>. Independent studies also support the idea that casual gaming has become a form of social activity. A 2005 Nielsen research report <sup>[5]</sup> reports that nearly two-thirds of a sample of 2000 players from Europe played with other players for at least an hour every week. Also 60% of the sampled gamers stated that the social component was the prominent feature that attracted them, further analysis show that the popularity of these games is influenced by the player's interaction skills, competitive spirit and his sense of achievement <sup>[6, 7, 8]</sup>.

Multiplayer is a feature often used in games to engage player participation in a game environment at the same time. The history of Multiplayer games spans over thirty years, the first games with networked support emerged in the late 70's making them extremely popular over the years. Social interaction and competition are factors that have had a decisive impact on the players' feelings and emotions while playing digital games. Since casual games currently are more frequently played with other players, player experience metrics for this type of game <sup>[12]</sup> have to be considered.

## **3. SIGNIFICANCE**

The significance of our research could be translated into better understandability of Player trends and better game design strategies by developers. The current research experiment has particular focus on comprehensive studies of player score and player experience obtained from playing casual games. This could possibly shape the future of game cultures, game design methodologies, playful innovation and also optimize emerging game modes such as the asynchronous multiplayer for a heightened sense of gameplay.

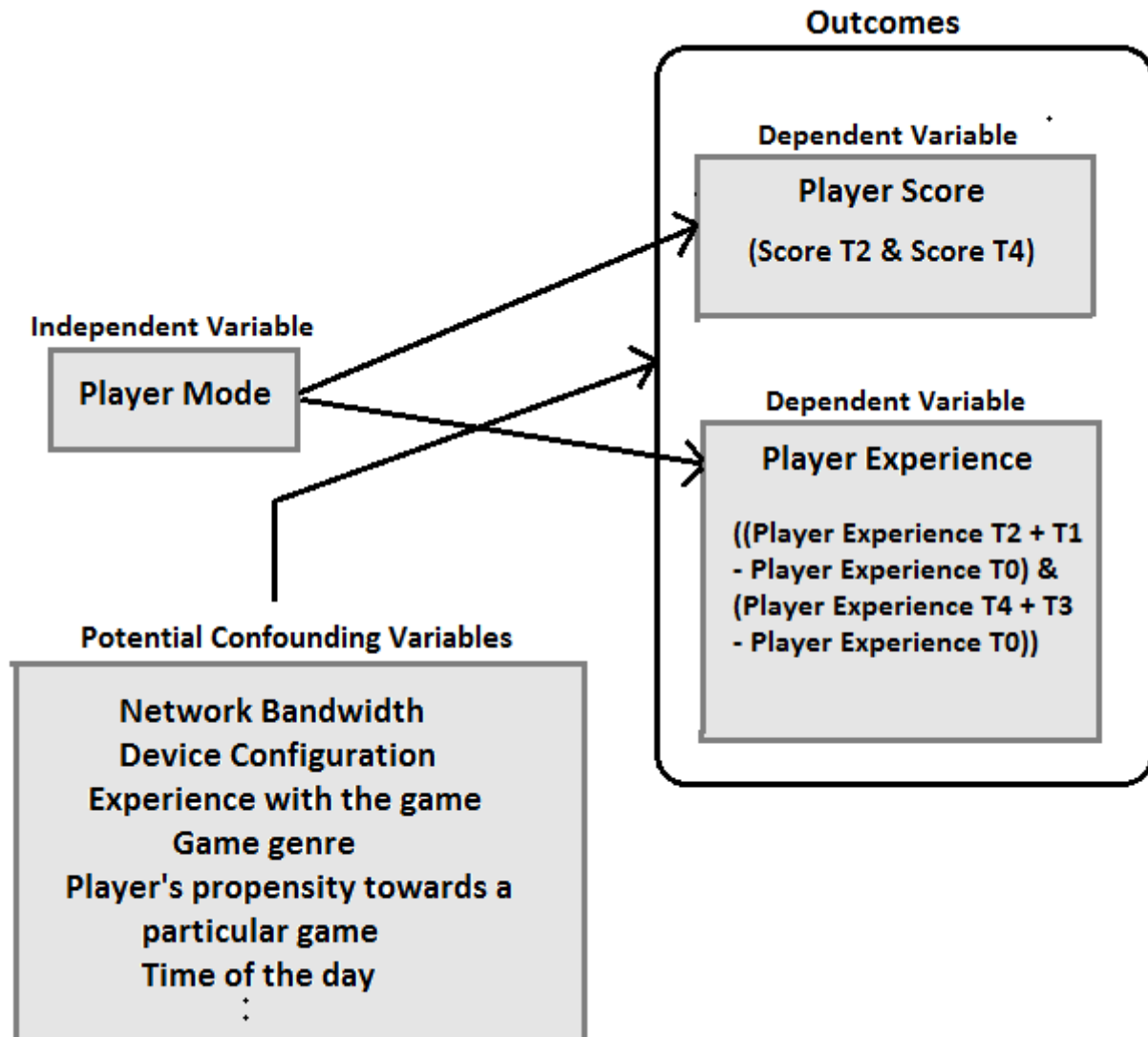
Also, we hope to enhance the current methods for measuring player experience in these social games, which could give rise to a valid and a comprehensive study of the casual gameplay experience.

## **4. RESEARCH DESIGN AND METHODS**

We propose to conduct a dependent measures experimental research in which each subject will be introduced to both the levels of the independent variable. The rationale behind adopting this approach is to identify whether a change in independent variable affects the dependent variable for the same subject i.e., does the score of the player change when he/she plays the game in an asynchronous multiplayer mode than on a single player mode. The participants will be asked to play in both single player mode and the asynchronous multiplayer mode and their score will be recorded. The Player will also be asked to fill an in-game player experience survey to measure our second dependent variable - Player experience. However, there has been disagreement on cumulative data of Likert's scale survey being interval or ordinal <sup>[11]</sup>, we believe that the cumulative sum is interval and can be used to draw better inferences using parametric tests, if assumptions are met.

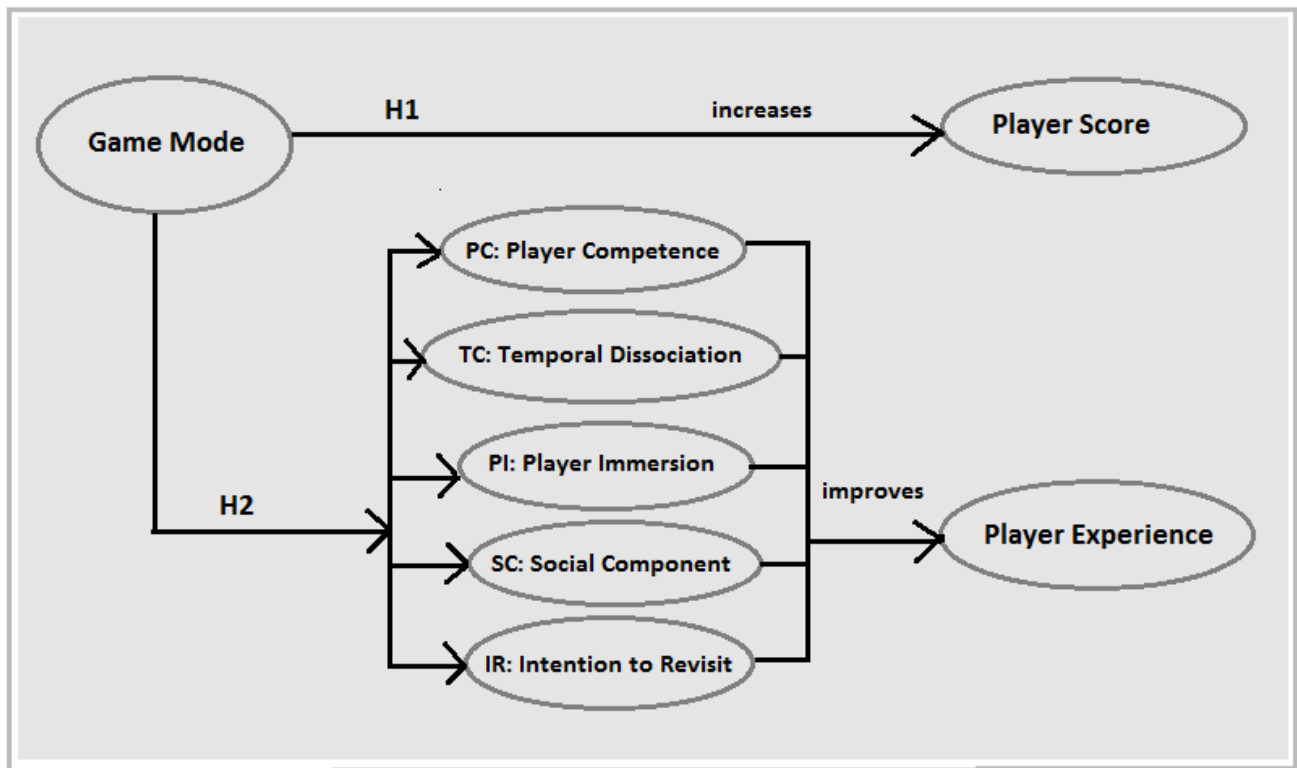
## 4.1 Models

The Research model, Figure 4.1, defines the variables to be measured and their relationships being proposed. Participants are assessed at 5 times during each experimental procedure. T0: a pre-test assessment; T1: during the first player mode randomly assigned to the participant; T2: immediately after the first player mode; T3: during the second player mode; T4: immediately after the second player mode.



**FIGURE 4.1** Details the Research Model, which lists the variables to be taken into consideration for measurement and their relationships. A list of potential confounding variables which would affect the outcome of the experiment is also listed.

The hypothesis model, figure 4.2, shows the relationship between independent and dependent variables chosen for the purpose of this research. The proposed independent variable, Game Mode, consists of two levels, namely, single-player and asynchronous competitive multi-player. The dependent variables chosen are Player Score and Player Experience. Player Experience is measured using 6 metrics <sup>[9]</sup>, namely, Player Competence (PC), Temporal Dissociation (DC), Player Immersion (PI), Social Component (SC), Intention to Revisit (IR) and Fun. These constructs are explained in detail in section 4.2.2.



**FIGURE 4.2** describes in detail the hypothesis model, with the two hypothesis of the experiment listed and the nature of the direct relation between the direct and indirect variables.

## **4.2 Variables and measures**

Dependent variables and independent variables considered for the purpose of this experiment can be observed from figure 4.1.

### **4.2.1 Game Mode (Single player Vs. Asynchronous Multiplayer):**

Games can be played in three modes: Single player, Competitive Multiplayer and Cooperative multiplayer <sup>[2]</sup>. In Single player mode, only one player is involved in the play. However, multiplayer can itself be divided in two categories: Asynchronous and Synchronous Multiplayer <sup>[3]</sup>. In Synchronous multiplay, many players play in parallel at the same time. However, In Asynchronous multiplayer, players play in a non-coordinated sequence and not in tandem.

### **4.2.2 Dependent Variables**

#### **4.2.2.1 Player Score**

Player score is the measure of player performance on completing particular level of game difficulty. Player score is ratio data, hence it can be effectively used to compare two values and perform parametric statistical tests which are powerful and can be used to draw meaningful conclusions. The player score was chosen as the preferred dependent variable as describes the direct relation between the player score and player performance. However, we would need to check if our data is normally distributed and whether there is homogeneity in variance in two groups of measured scores.

#### **4.2.2.2 Player Experience**

This section explains the experience of the player during the gameplay. The Player Experience is measured by taking into account the following constructs <sup>[9]</sup>:

1. PC (Player Competence): A degree to which the player feels he is competent to achieve the given objective.
2. TD (Temporal Dissociation): A degree to which players felt the game was engaging in terms of time passing away quickly.
3. PI (Player Immersion): A degree to which the player felt immersed in the game due to various reasons.
4. SC (Social Component): A degree to which the player felt drawn or detached to/from the game on the presence or absence of a social component.
5. IR (Intention to Revisit): A degree to which the player intends to revisit the experience.



#### 4.2.3 Potential Confounding variables

The following are some of the observed potential confounding variables:

1. Network Bandwidth
2. Device Configuration
3. Experience with the game
4. Player's propensity towards the particular game
5. Time of the day
6. Genre of the Game

#### 4.3 Population and setting:

##### Target Population

The Target population in consideration will be the students of Northeastern University. Student population at Northeastern University consist of Undergraduate and Graduate students. There are a total of 16,385 undergraduate students, 50.4% of which are male and 49.6% female. Thirteen percent of the undergraduate students are International students from nearly 122 countries. There are nearly 7321 graduate students which have good balance of International and local students. The ethnicity of students is shown in table below.

Ethnicity	Percentage
American, Indian-Native	0.1%
African-American	10.4%
Hispanic/Latino	3.7%
Multiracial	2.9%
Caucasian	59.8%
Unknown	16.9%

**Table 4.1: The population of Northeastern University categorized according to Ethnicity.**

##### Inclusion/Exclusion Criteria for NEU Students

- 1) Must not have any serious physical disability.
- 2) Must have experience in operating computers and mobile devices.
- 3) Must not be going through any serious psychiatric treatment/medication.
- 4) Must be greater than 18 years of age.

#### 4.4. Sampling and Statistical Power

We plan to sample from the target population mentioned in the above section. The sampling process would be random in nature such that all possible subsets of the target population are given an equal probability. In this way, we anticipate to minimize biases. The change in behavior of the sample

is representative of the change in behavior of the population.

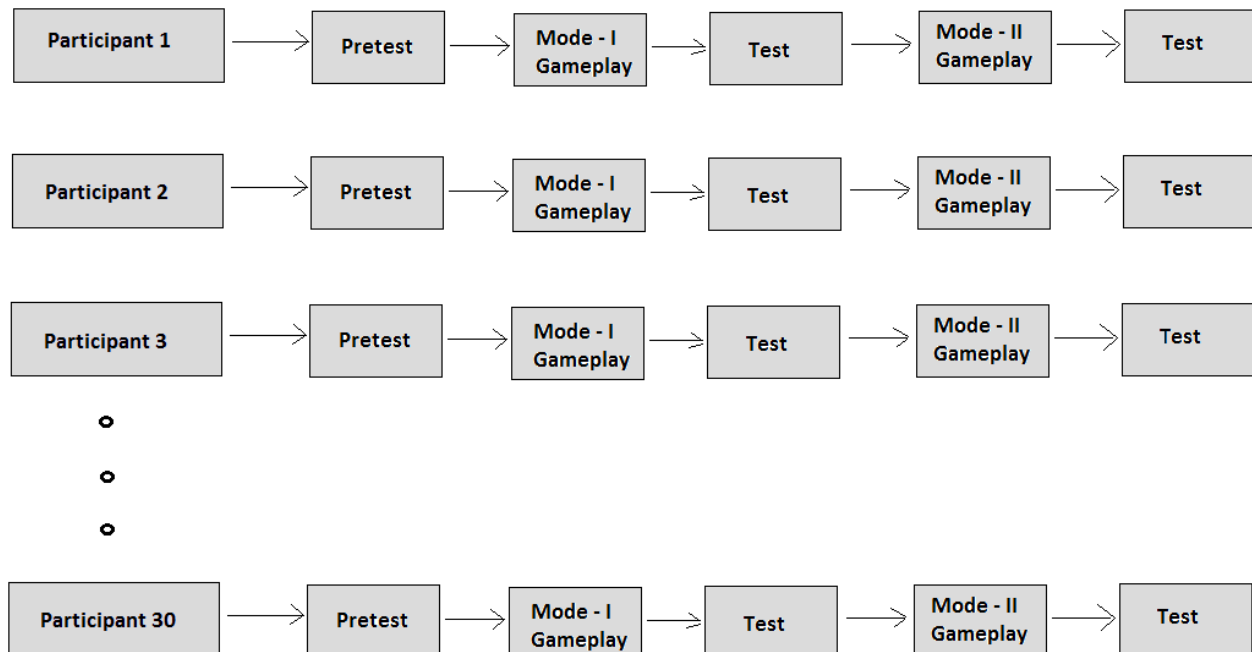
#### 4.4.1 Sample Size

For the purpose of this experiment, we consider using a small sample size of 30 people, the smallest sample size which can yield normally distributed data. We can perform various parametric statistical tests on this sample to obtain the effect size of our experiment. The smaller sample size also translates to reduction of costs incurred in recruitment and conducting the experiment. More on this is detailed in section 4.6.

However, with a small sample, there is a possibility of obtaining a non-representative sample. Moreover, drawing inferences require a great deal of control in the experimental process.

#### 4.4.2 Design and related risks

We adopt the repeated measures experimental design which could lead to order effects such as boredom and practice effects. In order to eliminate these effects, we perform counterbalancing. Practice effects and participant fatigue could lead to participant drop-out. To combat these, players could be given 10-minute breaks after they complete one session of gameplay. This is detailed in Figure 4.3.



**FIGURE 4.3: Describes the Repeated measures experimental procedure adopted for our research**

#### **4.4.3 Power Analysis**

A power analysis was performed for dependent mean t-test with single tailed configuration, we considered moderate effect size of  $d=0.5$ ,  $\alpha=0.025$ ,  $\beta=0.1$  and statistical power of 0.9. The sample size of 36 was found to be sufficient for the survey.

#### **4.4.4 Recruitment**

Advertisements will be posted at different residential, academic, recreation halls of the university to recruit participants. The specific requirements for eligibility will be specified in the advertisement. The participants will be asked to send their official NEU email address to us as a form of correspondence. Each student who responds would be given a unique number to protect his identity. A sample of 36 students will be randomly selected for participation. Since our sample size is 36, we expect our data to be normally distributed and hence can apply dependent t-test if there is homogeneity in variance of the two groups.

#### **4.5 Data Collection**

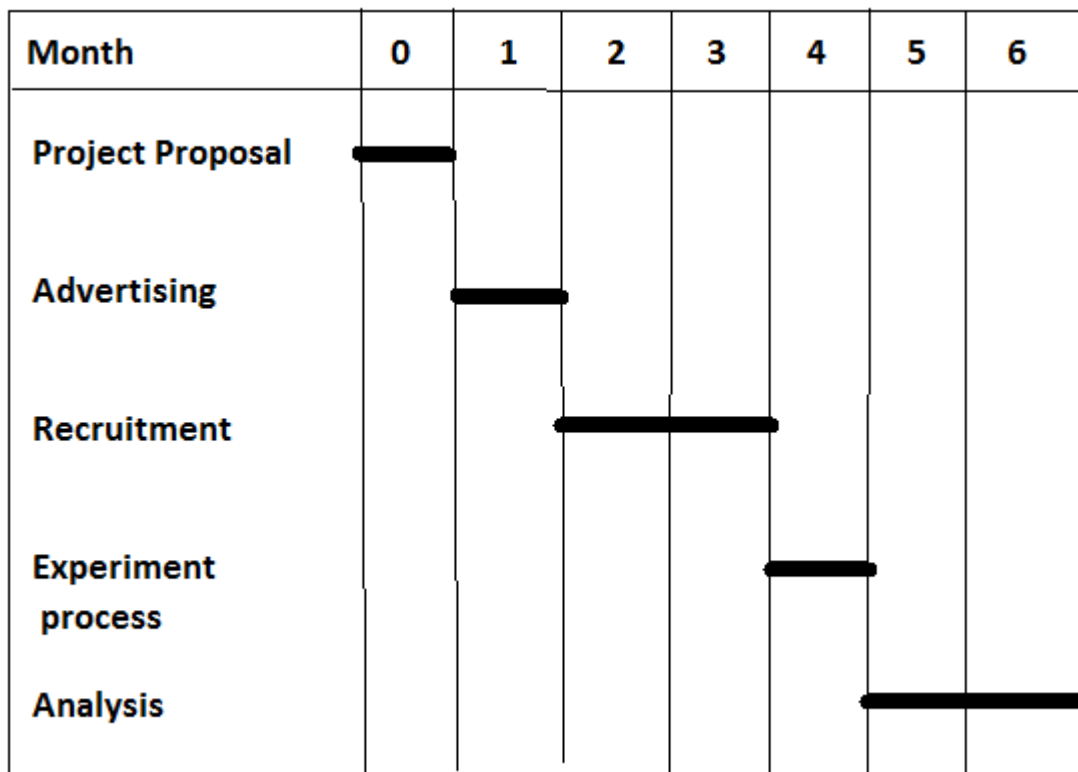
A pretest questionnaire will be sent to all participants to ask for their preferred time of availability, the type of mobile device they own and other questions that could be used to eliminate potential confounding variables. After analyzing participants' response, an appointment confirmation mail would be sent to them. All participants would be asked to fill out consent forms in order to be eligible to participate in the experiment. Once the appointments are confirmed with the participants, they would be allotted seats in reserved conference rooms on-campus. On the experiment day, half of the randomly selected participants would be seated in room-I, while second half of the participants in room-II. Room-I participants would engage in a play on the single-player mode while room-II participants play in and asynchronous competitive multi-player mode. After a round of gameplay and a post-game survey is taken, the participants in both rooms swap game-modes. This would randomize the learning effect across participants. The initial configuration of the device should be set up and a diagnostic test must be performed on all devices to ensure proper functioning before play. Also, the comfort level of the participants should not be compromised.

All participants would be asked to play in a practice mode first so as to allow them to familiarize the game's rules and mechanics. However, no score would be measured for the practice mode. After practice mode, all players will be asked to play in same level of difficulty in both modes for both the modes. During game play of each mode, participants will be prompted with an in-game player experience questionnaire to measure proposed player experience constructs, the Player Immersion and Temporal Dissociation.

A post-game survey would follow each gameplay, wherein the player experience constructs- Player Competence, Social components and the Intention to revisit would be evaluated. The participant scores would be recorded after each play through.

#### 4.6 Timeline and Experiment Protocol

The experimental process is expected to last for 2 hours, which will include Briefing, Assessments and Data Collection, Game Practice, Breaks and finally Participant Appreciation. On arrival of all the participants to the venue, the first 20 minutes would be spent in conducting Identity checks and assigning participants to their randomly allotted seats in a randomly allotted room. As mentioned, 15 participants would be seated in Room-I and 15 in Room-II. Since a repeated-measures design would be used to carry out the experiment, participants may be subject to Practice effects. To account for these effects, players in Room-I would engage in a single-player mode of gameplay whereas players in Room-II would engage in an asynchronous competitive multiplayer mode of gameplay.



**FIGURE 4.4 details the timeline of our proposed experiment**

Once all the participants are seated, they would be served with refreshments. It would be confirmed with every participant whether he/she has any allergy before the experiment. An assigned experimenter would do a briefing of the experiment after distributing printed material containing the rules of the experiment day's agenda. Once the participants gain a clear understanding of the experimental procedure, they will be asked to install the game on their smart-phone/device. Participants without smart phones will be provided with one of the rented devices acquired for the purpose of the experiment. The mobile Devices would operate on full battery charge, thereby eliminating the possibility of device shut-down. After extensive checks and measures are validated, we would proceed with the experiment.

As mentioned in section 4.5, the experiment would consist of the following phases in the same order:

1. Pre-test questionnaire: To get qualitative data about the participants.

2. Practice mode: No score will be recorded.

-A 10 Minute Break-

3. Mode-I of gameplay (single-player/asynchronous competitive multiplayer): Participants would engage in the first game mode randomly assigned to them. Scores would be recorded at the end of the play. However, individual scores will not be disclosed to other participants.

4. Player Experience Survey-I: A survey to gather qualitative data on player experience for the gameplay in mode-I.

-A 10 Minute Break-

6. Mode-II of gameplay (asynchronous competitive multiplayer/single-player): Participants would engage in the next mode of gameplay. Scores would be recorded at the end of the play. However, individual scores will not be disclosed to other participants.

7. Player Experience Survey-II: A survey to gather qualitative data on player experience for the gameplay in mode-II.

-A 5 Minute Break-

8. After the complete, participants would be provided compensation and appreciated for the participation. Once the participants leave, all the data will be stored in secure location.

## 4.7 Budget

The proposed budget for the experiment is listed below, while it is not a comprehensive list on the costs incurred in conducting the experiment from start to finish, it does give us a rough estimate on the major costs involved.

Item	Expected Cost (in dollars)
Participants' Compensation	\$900 (30 people)
Advertisement for recruitment	\$50
Additional mobile Devices	\$1000
Observers for experiment	\$400
Assistant for research	\$3,000
Personal Computer for research	\$500
Miscellaneous	\$500

**Table 4.2: Costs involved in conducting the experiment as well as the stakeholders involved.**

## 5. ANALYSIS

The analysis will compare the randomized data collected after intervention of our independent variable. We expect to see a positive change in players score and player experience after intervention of second level of independent variable. Our analysis for our two different dependent variables (Score and player experience) will be done using two different tests. Since score is ratio data, we will perform parametric statistical test on it. However, as mentioned above, we have chosen player experience survey data as interval; we would apply dependent means t-test on it. If we consider it to be ordinal, we would have applied non-parametrical test to it.

For score, a t-test for dependent means will be conducted on changed scores for each of the dependent variable with  $\alpha=0.025$ . If observed t value is greater than critical t-value, we will support our hypothesis otherwise null hypothesis will be supported and finally helps us redefine our hypothesis and perform the experiment again.

For player experience, we referred to the game experience questionnaire developed by Ijsselstein et al (2007) where all survey questions are answered on the same scale 0-4, and questions are developed on the factors of Immersion ,competence, social presence, flow(disassociation) etc <sup>[10]</sup>. We chose the question that is applicable for our game and our constructs. The Survey questions and Scale are given below:

not at all	slightly	moderately	fairly	extremely
0	1	2	3	4

### **Player Immersion**

1. I was absorbed on the objective during the game play.
2. I forgot what was happening around me when I was playing the game.
3. I wish I could play for longer

### **Temporal dissociation:**

1. I felt time passed by quickly while I was playing the game
2. I lost track of time while I was playing the game

### **Social Component:**

1. I feel more competitive when I was play against others
2. I find it more enjoyable when I play in multiplayer mode
3. Beating others score give me more satisfaction than beating my score

### **Intention to revisit:**

1. I would like to play this game again
2. How frequently would you play this game?
3. What feature makes you think you want to play this game again? → open-ended

### **Player Competence:**

1. I felt skillful while I was playing.
2. I was fast at reaching game's target.
3. I felt game was easy for me.

A cumulative total based on participant's responses will be taken as player experience for the mode; however we believe we could have added more question to make it more comprehensive. The cumulative total can be argued being ordinal or interval, as mentioned above, we would consider it as interval. A t-test on dependent means will be applied after checking assumptions with  $\alpha=0.025$ . If measured t value is less than critical t-value, we will assume null hypothesis to be true.

## **5.1 Limitations**

Since our target population is Northeastern University students only, the results of our experiment may hold true for them only. Moreover, we are focusing on one particular genre of the games; hence the results of our study could be legible for that particular genre only. Furthermore, games within a genre of games also differ at various levels hence there are many factors which would limit the external validity of our proposed research. To make our results externally valid, we

would need a diverse target population and more diverse range of the games. But this would make the sampling process more difficult to get a perfectly random sample and would make the study longer since participants will be asked to play many games rather than one game.

## **5.2 Issues and Potential Risks**

The experiment will last for about 2 hours and may lead to participant fatigue, if they are asked to play continuously on that day. To combat participant drop-out we plan on providing incentives. Players will be given breaks for 10 minutes after they complete one mode and once they complete their allotted survey questions for that mode. Since students at Northeastern university come from diverse backgrounds, ethnicity and nationality, language can be a barrier for some of them and might affect their responses to survey questions. This can be solved by keeping the language of survey questions easy to understand and also providing them necessary translation aid if required. The survey won't be long and strenuous to prevent fatigue.

## **5.3 Human Subjects and Ethical Issues**

We will follow Belmont's three principles to conduct Human Research:

1. **Respect for persons:** We will make sure that participants comprehend all the risks and potential benefits for participating in their research. Participation will be voluntary and no coercion or excessive compensation will be used to recruit participant that might influence their decision. Any participant can move out of participation whenever he/she wants.
2. **Beneficence:** We will make sure that our research will pose minimum risk to participants, physically or psychologically while participating in experiment.
3. **Justice:** All the participants will be treated and compensated equally for the research, no bias whatsoever will be shown towards any group.

Moreover following issues will also be taken into consideration for the rights of human subject:

**Confidentiality of Participant's information:** The participant's personal information will be kept confidential and won't be shared with anyone under any circumstances.

**Persons with diminished autonomy:** Persons with diminished autonomy will be given additional rights and support.



#### **5.4 Data Safety and Monitoring:**

Data is of utmost importance for our proposed research, but since our study requires human subjects, confidentiality of data is of equal significance. Once we get all the required information about the interested participant, individual profiling will be done and through study of IRB guidelines, will be performed to understand the participant's right and experiment protocols to be drawn. The participants' personal information will be stored in a secured computer with limited access granted only to researchers. Once the experiment is complete, the names of all the participants will be encrypted to protect their identity and their encrypted codes will be used when the results are published.


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## 7. APPENDIX

### NIH CERTIFICATIONS





### **Certificate of Completion**

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Deepak Jayaram** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 06/15/2013

Certification Number: 1198677



### **Certificate of Completion**

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Guanlun Xu** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 06/17/2013

Certification Number: 1199360