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Pervasive games in modern mobile technology

A user study

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Master of Science in Computer Science

Submission date: June 2010

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Problem Description

In this project, the students are going to study the usage patterns in pervasive games implemented in modern mobile technology (smartphones). Usage patterns mean when applications are used and in what kind of daily life situations they are used the most. Do users go to their mobile platform for entertainment as a main activity, or is the interaction a result of other activities (example: waiting for the bus, traveling by bus, etc).

In recent years, technology advancements have changed and will continue to change the way we perceive and play games, and in this project the students will study if pervasive gaming is an interesting concept to users, and what are the user's intuitive attitude to different elements of pervasive technology. This study will serve as a base for further research on pervasive gaming which explores actual play feedback and potential market value by more focused surveys and particular data collection.

Assignment given: 15. January 2010
Supervisor: Alf Inge Wang, IDI

Abstract

This master thesis presents the results from investigating usage patterns on portable devices and finding gamers attitudes towards different pervasive game elements.

The main motivation of this project is to help developers create a better game experience with the use of pervasive elements and mobile technology, finding some pointers as to what players are likely to enjoy (or not). At the same time, the usage patterns will help us understand how players currently use games, which is important information creating games tailored to the players usage patterns.

The results for usage patterns shows that game sessions are usually very short. We found that most people do not utilize multiplayer functionality in games on portable platforms. Investigating why players play games on portable devices, we found that quite many only use games as a secondary activity. Often, playing on portable devices are a result of some other main activity, like for example waiting for some form of transport in real life.

To better understand what types of pervasive games users would be interested in, we proposed four concepts and asked the participants for their opinions of these concepts. Of the concepts proposed, the most popular concepts were one in which the game used the users geographic location to create questions from the nearby area and a concept where the game used proximity to other players as a part of the gameplay. Generally, we saw that players liked the idea of playing games with others in teams, and often as a planned event where people meet up to play.

To understand what elements are likely to be successful, we studied attitudes towards the different categories of game elements. Some elements, like visual and sound feedback are staples of modern games, and therefore a necessity. Another popular output method is force feedback, in which the game shakes the controller or in other ways provide tactile feedback. Social elements were the most popular, competitive and cooperative game styles along with chat/communication abilities are important to players. Players also wish to be able to play anywhere and be able to start and stop playing at any time.

PREFACE

This master thesis presents the work and results from researching pervasive game elements and usage patterns on portable devices during the spring of 2010. The project was carried out by Are Akselsen and Kenneth Kristiansen at the Department of Computer and Information Science (IDI) at the Norwegian University of Science and Technology (NTNU).

Acknowledgments

We would like to thank the following people for their contribution to our master thesis:

Meng Zhu, for excellent guidance during the master thesis period.

Alf Inge Wang, for guidance and accepting the assignment.

Apps AS, NTNU and Tor André Wigmostad at NetCom AS, for helping us distribute the surveys.

Survey respondents, without the survey respondents this master thesis would not be possible.

Trondheim June 11th, 2010

Are Akselsen

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Part I

Introduction

Project Background

Over the last few years, smart phones have experienced increased popularity. This is especially due to the introduction of new technology which has made the devices more complete. This new technology or technology device, usually support wireless Internet access, bluetooth, 3G, GPS, cameras (both still and video), music and video playback. It also has larger monitors than before, and increased user friendliness. The devices have, along with the rest of the computer technology, seen great performance increases. All these advancements put together has made the smart phone much more common than only a few years ago. With all this technology in these relatively small devices, they are carried around with the user at all times. The technology integrated in these devices today, makes it easy to have the device share information with other devices, using the Internet, local area network, cellular networks (3G, GSM) and bluetooth. This makes the device ideal as an entertainment platform, and owners regularly go to the smart phone for entertainment.

Today, entertainment on these devices are usually small games, music or video. More could be done to research how and when users play, and to which extent games utilize all the technological opportunities which lies within these incredibly sophisticated devices. Multiplayer games have been a great success in stationary devices (personal computers, consoles et cetera) for some time, with lots of different games targeting more and more of the traditionally non-playing computer users. On mobile devices such as the smart phone however, multiplayer functionality has yet to reach the same usage level as for the stationary devices. Games could bring all the technology together, enabling players to play multiplayer - using wireless networks, positioning technologies et cetera, making the gaming experience a more integrated part of the real world. With a mix of both the real and virtual world, the gaming experience and possibilities could be enhanced. This could change the way we play games.

1.1 Pervasive Games

For pervasive games, one could imagine a broader usage area than for traditional games. Consider an event, much like paintball, in which a group of people gather and play some kind of game, each player equipped with a mobile device such as the smart phone. This could be a marketing event, for example in a mall, or it could be in a more fixed setting, just like the paintball event. In recent years, radio shows have had popular competitions where the objective is to locate a person walking around the city - placed there by the radio company. An approach using mobile games with pervasive elements could be placing virtual items around the city instead, enabling users to collect these items in some way, competing for a prize. Another example could be a real world edition of the traditional outdoor sport and computer game mode “capture the flag”¹. This kind of usage we call “event driven” game modes.

Tourism could also utilize pervasive elements. For tourist attractions, applications or games could be developed that help increase the knowledge about the attraction. For large tourist cities for example, one could have some interactive quiz around the city, enhancing the tourists experience with the help of pervasive applications or games.

¹Capture the flag is a game concept where two teams each have a flag and the objective is to capture the other team’s flag, located at the other team’s base, bringing it safely back to their own base.

Team building² is a popular way of building teams. Events like this could also be a target for pervasive games and applications.

To our knowledge, this game mode is not widely used commercially today. In our research, we would like to see players opinions towards these kind of game modes.

1.2 Pervasive games research

After an initial study of pervasive games, we found that there is a lot of research done in this area. Many of the researchers have created game concepts with pervasive elements, and deployed these concepts to players - investigating their usage patterns and attitudes towards the games.

A long-term study of a location based game was done by Bell et al. using a game called Feeding Yoshi [3]. The study, relying on player diaries, interviews, observation and system logs revealed the players reactions towards the game. The goal of the game is to gather fruits for characters found around cities, called Yoshies. Wifi networks were used for placement of the fruits and Yoshi (open networks became fruit plantations and secured networks are Yoshies). The researchers found that players enjoyed going out specifically playing for a couple of hours, and some players reported the game as high addictive. Players were willing to both change their daily routines to achieve a higher score, and also set aside time for the game itself. It was also reported that players would like to play in speed, meaning while they were taking a bus, and similar activities with downtime. Seeking open and closed wireless networks and utilizing this in the game were enjoyed by the players.

For developers, using existing wireless networks reduce the need for maintenance. One does not have to place out any objects, the objects are already there. However, the game experience is really dependent on the availability of wireless networks. This might depend on the players transportation methods, where they live, and so on.

²Team building is pursued via a variety of practices, and can range from simple bonding exercises to complex simulations and multi-day team building retreats designed to develop a team.

Exploring asynchronous gameplay, the game *Mythical: The Mobile Awakening* was developed by Saarenpää et al. [30]. The game features context-aware gameplay, where real world phenomena have an effect on the game world. Three types of context information are used: spatio-temporal, environmental, and proximity. The player performs rituals which utilize different context information. The game was played asynchronously using game intervals, much like a kind of turn based game. Results were produced using field trials, interviews and questionnaires. The results showed that players fitted the game into their other daily activities, and although asynchronous gameplay was a new experience demanding some getting used to, the concept was liked as it gave the players the opportunity to leave the game running when they were performing some other activity.

Several other researches have done similar work. Cheok et al. developed a capture the flag type of game using smart phones and GPS on a small campus area, finding that although the game was somewhat limited due to technical challenges, players enjoyed the game [7]. That game could be classified as event driven.

Can You See Me Now [10] is a game developed by Flintham et al. designed to be a fast-paced game in which up to twenty online players were chased across a map of the city, by three runners. The goal for the players was not being caught by the runners. Players used handheld computers with wifi, communicating via audio, using GPS for position tracking. The player feedback was mainly positive, however, the developers were faced with some challenges and proposed some recommendations for future developers of similar style games:

- ▷ *Don't be over-reliant on GPS, especially in urban environments. Don't mistake resolution for precision.*
- ▷ *Design interfaces that explicitly communicate the presence and nature of GPS error and that encourage participants to see location as just another (possibly unreliable) source of information.*
- ▷ *Seriously consider using real-time audio as a rich but not overly precise source of context.*
- ▷ *Consider ways to exploit richer forms of contextual information, especially temporal characteristics of the experience and participants' local knowledge.*

Another game which to our consideration fully qualifies for the event driven game category is “The Drop” [31]. As described by the developers: *two teams use mobile phones to play a version of “capture the flag,” where one team hides a virtual “briefcase” in a public place and the other team attempts to find it within a specified amount of time. If the team that is searching for the briefcase finds it within the game’s time limit, they win: otherwise, the team that hid the briefcase wins.*

The game is not implemented yet, but it is a concept which really defines our event driven game type. In their concept, they describe a deployment in a mall, considering several possible problems both for players and developers.

1.3 Pervasive games challenges

Pervasive games are met with several difficult challenges both of an technical and non-technical art. Technical challenges are investigated in chapter 4.

From our initial research of pervasive games, we identified numerous important challenges today:

- ▷ Privacy concerns
- ▷ No big commercial success games making the way for others
- ▷ For location based games: need for local users
- ▷ Need of particular devices
- ▷ Social acceptance

Mixing the real and virtual world obviously means that games must collect real world data. A typical example would be location-based games, in which the game must know the location for the player. Storing this sort of data might create privacy concerns for the end user. Users may need to be able to control how much data is shared, the flow of data, and know who is getting access to these data. For the even more complex games of the future, which may for

example monitor the players health and use that for game elements, it is even a bigger privacy concern.

A pervasive game with big commercial success, bringing players with their devices to the streets, would obviously make the road less bumpy for other pervasive games. As long as pervasive games still have not had a major commercial success paving the road for others this is an issue waiting for be resolved. Social acceptance is a matter here as well if players are to go out and play pervasive games in public, which might seem weird, players need to feel that it is accepted to do so.

For location based games, the need of local users are important for the game experience. If a gamer logs on his location based dueling game, and no one or very few players are online in his or hers area, the game experience might be less fun than intended.

Also, in order to bring games to the largest segment of people possible, it is a problem that not everyone have the devices required for such games as of now. Location based games probably need some sort of wifi or GPS antenna, while standard cellular phones yet have not got this technology.

Benford et. al.[4] adds a few issues:

- ▷ Handling localization uncertainty
- ▷ Localization dependent configuration

Handling localization uncertainty is a semi-technical problem. The reason for the problem is players not always being able to find a precise location. In dense urban areas with tall buildings for example, GPS might not be accurate at all. This issue is all about handling the problem - while waiting for the technology to improve. How does one present this problem to a user, and so on.

If a developer creates a game in which have some local problem to be solved, it will need configuration for all areas that are to be played. For example a quiz game in which a players is asked questions from his or hers local area - someone need to administer and create those questions. Further on, some games might require resets or similar activities. Spreading a game all around the world therefore introduce some configuration and management problems for the developers or distributors.

1.4 Project motivation

This project is a part of the research in pervasive games at The Department of Computer and Information Science (IDI) at the Norwegian University of Science and Technology (NTNU).

The main motivation of this project is to help developers create a better game experience with the use of pervasive elements and mobile technology, finding some pointers as to what players are likely to enjoy (or not). To do this, we believe that there is a need to find out how players find the idea of mixing elements from the virtual and real world in games. How players currently use both regular and games on mobile technology - and how they perceive and will use pervasive games.

Problem Definition

One of the parameters we are going to study are the usage patterns in (pervasive) games implemented in modern mobile technology (smart phones) and other similar portable devices. We define usage patterns as: when and where applications are used and in what kind of daily life situations they are used the most. Do users go to their mobile platform for entertainment as a main activity, or is the interaction a result of other activities (example: waiting for the bus or similar activities)? One of the goals for this master thesis project is to understand how players play mobile games on devices like the smart phone.

A part of the project is to look at pervasive games today. What are pervasive games, are there currently any games out there attracting large masses of players? One objective is to see if pervasive games could bring mobile gaming to a larger segment of the population. Another is to figure out how pervasive games could be designed to be more attractive, and how these games will change the way we play mobile games. The project will explore both the advantages

and disadvantages of the pervasive style game, asking the users themselves, and analyzing current trends.

The research from this project will try to help developers create a better game experience using pervasive elements, by:

- ▷ Investigating how players use mobile games today
- ▷ Identifying pervasive elements that are likely to be (or not to be) enjoyed by players
- ▷ Revealing players attitudes towards and potential usage patterns for pervasive games
- ▷ Investigating players attitudes towards new game modes using pervasive elements, for example the “event driven” game

2.1 Project Scope

It would be interesting to see how current games utilize the opportunities in mobile technology and whether current approaches are appealing to players. Also, if this new approach to games could attract more non-players. Investigating what players are attracted by, and how they would utilize such a game. Developing games for mobile platforms could be relatively easy from a technical point of view. Most software developers can develop games in some fashion. However, developing a successful game is something else. The most elegant and impressive games from a technical perspective is not always the most popular games. Recently, many of the popular games for mobile platforms are old games rewritten for some mobile platform. There are several success factors to consider creating computer games, from several different points of view. Marketing, technical development, platforms, and so on.

With our background as engineers having some experience developing games and a genuine interest in this area, we obtained some knowledge about pervasive games. Finding that pervasive games are a relatively new and interesting field in game development, we studied the existing literature and games. When developing new games we believe it is important to analyze and understand

how players use games today. Example: If the usage patterns for mobile games suggest that game sessions usually are below 15 minutes, creating a game that requires the full attention from a player for longer periods of time might be a factor for non-success. We wish to understand usage patterns for mobile games, helping developer create games that are in line with the current usage patterns. In our study we found that we could not see many commercial success stories for pervasive games today. This is why we want to do research into games with pervasive elements.

For pervasive games, our impression is that games with pervasive elements still are not widely used among non-hardcore players. Therefore, we will find attitudes towards pervasive elements both among current pervasive game players and non-players. It is obviously easier for developers to create a successful game if they know what the user believes he or she will enjoy. The goal for this project is to help developers understand players attitudes towards pervasive elements, hopefully helping developers on the way to the first pervasive killer apps¹ (games).

2.2 Usage patterns

The term usage patterns might be somewhat unclear. With our context of game usage patterns, with a focus on games on mobile devices and technology, we include the following parameters in usage patterns:

- ▷ Game session frequency: how often does a player start a game session
- ▷ Game session length: for how long does a player usually use a game
- ▷ Main activity or product of some other activity: is the player using the game only while waiting for a bus, cooking dinner, and so on
- ▷ Intention or motivation for playing a game
- ▷ Multiplayer usage and social situations: does the player use multiplayer, how often does the player play with friends - in real life? Over the Internet and similar technologies?

¹From Wikipedia: A killer application (commonly shortened to killer app), in the jargon of technologists, has been used to refer to any computer program that is so necessary or desirable that it proves the core value of some larger technology

2.3 Research questions

As mentioned, the motivation behind this project is to do research into how developers can make better games for portable platforms, and especially games with pervasive elements. The research goal is to help mobile game developers understand what kind of game they should work on, creating a successful game. Therefore, we setup a few different parameters we mean are important for a successful portable computer game.

One of the parameters are usage patterns. Usage patterns are information about: how often does players use games on portable devices? Why? For how long? In order to answers this, we developed a usage pattern definition and framework, and created RQ1.

We believe it is important to find out if pervasive elements could bring games to a larger segment of the population. Maybe pervasive elements could bring gaming to a whole segment of people not usually playing games. What do people think about pervasive elements? What are the good and bad sides about these elements? That is the motivation for RQ2 and sub questions.

Early in the prestudy, we found some pervasive games utilize event driven game modes. This sparked our imagination, so we immediately pictured a sort of event like the real world paintball event, where players meet up with their paintball guns and play for hours. RQ3 asks users about their attitudes and opinions on this game mode in RQ3.

RQ4 and RQ5 are directly related to our goal of helping developers understand what game concepts and pervasive elements are likely to succeed. If people like pervasive elements, which elements are most likely to be popular? Which elements are not? We believe that these are very important questions to answer in order to understand what direction to take with pervasive games and elements.

Our motivation leads us to the following questions:

RQ1 What are the players usage patterns for mobile games?

RQ2 Does pervasive games bring games to a larger segment of the population?

RQ2.2 Does pervasive games recruit individuals that does not normally play games?

RQ2.3 What are potentially new players attitudes towards pervasive games?

RQ3 For pervasive games, does event driven game modes bring additional value to games?

RQ4 What pervasive elements are liked? Are there any differences in population subgroups based on gender, income, age or social status?

RQ5 What pervasive elements are not liked? Are there any differences in population subgroups based on gender, income, age or social status?

Part II

Prestudy

Research methods

There are several different possible approaches for achieving the results we are looking for. In order to evaluate the candidates we researched, we ranked the possible methods based on what criteria we think are most important for our project.

The criteria are time constraints, budget constraints, quality of response, deployment, risk and relevance of data. For each of the criteria, each method is given a score. The score is summed up towards the end.

Here we show how this choice was made, along with some discussion and a final choice for research method.

3.1 Method evaluation criteria

Based on our research questions and goals, there are several methods that may enable us to collect the data we need. The methods are constrained by limited time and resources, but need to enables us to:

- ▷ Get feedback and information on what kind of individuals that are playing games on several different platforms
- ▷ Understand usage patterns on mobile games
- ▷ Present and get players opinions on several different pervasive game concepts
- ▷ Get user feedback on several varying degrees of proposed pervasive game types and elements
- ▷ Feedback from a lot of users about several topics and game elements are needed.

We have defined these criteria important for choosing the method:

C1 Time constraints

The project has a limited time span. Therefore the required time period of a method is important.

C2 Budget constraints

The project has very limited resources. We have no funding, and must get this from our supervisors budget.

C3 Quality of responses

How much information can we get from a response, and will the information itself be accurate?

C4 Deployment

How easy is it to reach many people with this method? The more responses we can get, the better our data will be.

C5 Risk

How risky is the method? Is there a potential for it not to work?

C6 Relevance of data

How relevant is the data collected to answering the research questions?

The chosen research method or methods need to be able to fulfill the requirements described above.

3.2 Method candidates

The following research methods are able to address the criteria described in the previous section:

- ▷ User survey by questionnaire:
 - ▷ Self-managed (Internet survey, mail survey)
 - ▷ Interview based (single interview, focus group, telephone survey)
- ▷ Field trials: develop a game and use field trials to get user feedback using different methods:
 - ▷ Interviews
 - ▷ Questionnaire
 - ▷ System logs

3.2.1 User survey by questionnaire

The self-managed questionnaire method is relatively low cost, and might enable researchers to get a lot of feedback on the desired topics reaching a potentially large geographical area. Possible respondents are very familiar with this kind of research, which is positive collecting results. A questionnaire can be completed almost anywhere and at any time, independent of the researchers presence. It

might also be a good way to collect sensitive data. The Internet version of this survey provides a easy method of administration the survey: spreading it, collecting and analyzing data. In a mail survey, this is more challenging.

The method is very dependent on the development of the actual questionnaire and the method used to deploy it and collect answers. Failing to address common issues in questionnaires might leave researchers with no result at all. It is also dependent on having some sort of population which are motivated to respond. Further on, it might not give the researcher a 100% correct representation of data, due to the respondents limitations on how they remember, perceive their own life, etc. This is a risk factor, as the project team have very limited experience and knowledge about survey design.

The interview-based survey is more costly for researchers and demands a lot of research resources for performing the actual interviews. To get a good result, the interviewers also need to be trained for this kind of situation. However, the individual response might be better due to the interview situation. To achieve a higher amount of responses, this could be done as a group interview. Although a group session might be good for the amount of responses, it is not good for sensitive issues. Sensitive issues is important to address as respondents answers might change due to this fact. It is also difficult to understand what could be sensitive for different kind of individuals. The interview survey also require facilities for the interview to be performed in. Getting a motivated population for the interview might be more challenging than a self-managed questionnaire, as it would require more time and effort from the subject.

Method score

In the table below are the different methods and criteria. The different methods have been given scores based on how they fulfill the criteria.

Table 3.1: User survey method evaluation

Method	Time	Budget	Quality
Questionnaire by Mail	Medium	Poor	Medium
Internet questionnaire	Good	Medium	Medium
Subject Interviews	Poor	Medium	Good

Method	Deployment	Risk	Relevance
Questionnaire by Mail	Medium	Medium	Good
Internet questionnaire	Good	Medium	Good
Subject Interviews	Poor	Medium	Good

3.2.2 Field trials

Field trials are good for getting user data on a single game project. This could give researchers access to the actual information, the facts, about most usage patterns parameters. A questionnaire based approach alone would only facilitate data that the user remembers, not the factual data. In a field trial, one would develop a game, and later get feedback from users by several means of data collection:

- ▷ System logs
- ▷ Interviews
- ▷ Group discussion and interviews
- ▷ Questionnaire

Field trials require more resources than a survey, especially due to the fact that an actual game has to be developed, tested and deployed. A high number of participants could also be difficult to achieve, actually depending on the quality of the game itself. For researchers that need to explore several games or game concepts, this method would be very time consuming.

It is uncertain to what degree subjects are affected by the fact that they are participating in a field trial. Subjects might have better motivation for playing

a game that they were selected to play in a study, than in a normal game situation. Further on, lack of certain game mechanisms may have an affect on the research results. A poorly implemented game feature might disturb or otherwise affect the research result.

Method score

In the table below are the different methods and criteria. The different methods have been given scores based on how they fulfill the criteria.

Table 3.2: Field trials research method evaluation

Method	Time	Budget	Quality
Interviews	Poor	Medium	Good
System logs	Medium	Good	Medium

Method	Deployment	Risk	Relevance
Interviews	Poor	Medium	Medium
System logs	Good	Medium	Poor

3.2.3 Method summary

If we summarize the criteria of the methods we can use the sum to compare methods. For the comparison we will use the numeric values: 1 for poor, 2 for medium and 3 for good.

Table 3.3: Research method summary

Method	Score
Mail questionnaire	12
<i>Internet questionnaire</i>	15
Survey interviews	12
Field trial with interviews	11
Field trial with system log	13

3.3 Chosen research methods

Initially, we planned to use field trials for our game research. However, after analyzing risks in the different available methods, we have chosen to develop a questionnaire based approach.

The reason for choosing this method is basically our research goals. We do not believe that we will be able to develop and test several games with the required number of people in the given time period of this project. And even if we theoretically were, the risks are too great - possibly leaving us with a time consuming game development process and test period - with limited results.

As stated earlier, we would like to see a lot of different players opinions on several different pervasive game elements. This would not be possible in a field trial, but is very much possible in a questionnaire. Another goal in our research is to study usage patterns in mobile games. By deploying one game, and studying the usage patterns for that game, the results would not be valid for any game but the game tested. Obviously, a questionnaire might be biased by the subjects perception and memory, reporting the wrong usage patterns. Researchers need to be aware of this effect.

To be able to target the right audience for our usage pattern and pervasive game concept study, we will create two questionnaires. One for usage patterns and one for the pervasive game elements study. The goal is to make the first questionnaire relatively easy and not very time consuming to answer, while the other one will be more extensive. In order to avoid potential respondents skipping out using one extensive survey, we will compensate for this by using two surveys instead, giving us more data on usage patterns.

One example for a game development research project is the SupaFly game [25]. The developers had the goal of saying something about social connections, but due to a lack of features in their implementation, they were unable to answer some of their research questions.

The research methods are elaborated on in chapters 8, 9 and 10.

To summarize, we are going to use the following research methods:

- ▷ Internet based self-managed questionnaire I: user pattern survey
- ▷ Internet based self-managed questionnaire II: pervasive game concept study

Domain knowledge

For readers not familiar with the term pervasive games, we explain the term along with some technical challenges related to pervasive games or games with pervasive elements in section 4.1 and 4.2.

While having a category of games called pervasive games seems logic, it is not necessarily appropriate. Instead, we have selected a definition where games have pervasive elements, rather than being put in a pervasive games category.

4.1 Pervasive games: Definition

There are currently many definitions for pervasive games out there. The Oxford Dictionary of English defines a clear meaning to the word pervasive as an adjective meaning *spreading widely throughout an area or a group of people*. This meaning however, cannot be directly applied to the term pervasive gaming.

A generally accepted definition has not been found, but several researches have tried to clarify it. Eva Niuwdorp have done some research clarifying the term [28]. The report includes a literature survey identified different perspectives as a problem when researches are defining pervasive games. The results of this literature survey are the following definitions or explanations:

- ▷ *a game that depends primarily on pervasive technology and nonstandard input devices*
- ▷ *an existing game that is augmented by computers, resulting in a blend of the real and virtual worlds*
- ▷ *a game that pervades the real world in an undefined manner, and thus blends with it*
- ▷ *a specific setting of the game world within the real world*
- ▷ *a game that blurs the boundaries between itself and the real world*
- ▷ *a game that is an overlay of the real world*
- ▷ *a game with a persistent presence in the real world, and thus available to the players at all times*
- ▷ *a game where the gameplay interacts with elements of the real world, thus challenging standard gameplay conventions*
- ▷ *a game where there is mutual interaction among players and elements in the real world*
- ▷ *a game that blends with everyday experiences*

The report suggests that achieving the ultimate definition for pervasive games is not suitable. Instead of trying to define what pervasive games is, the article uses the term pervasiveness:

“By looking into when, how, and perhaps even to what extent we can call a game pervasive, we can approach pervasiveness as a characteristic that can be applied to different levels and perspectives of pervasiveness, which then becomes a concept that can be applied across different genres, particular games, and even play.”

As stated in the report, one should ask what makes a game pervasive. This is where pervasiveness becomes one of the games characteristics. So instead of a definition of pervasive games in general, we will look at what makes a game pervasive.

We believe that pervasive games are built from the combination of three essential technologies: mobile devices like the smart phone, some sort of wireless communication and location-finding technology, detecting where and what the player is doing. This helps extend the gaming experience to the real world, combining both virtual and real world elements. A pervasive game should then be, as Benord et al. [4] describes it, a game with elements that use technology to *“deliver a gaming experience that changes according to where they are, what they are doing, and even how they are feeling”*.

4.2 Pervasive games: Technical challenges

There are numerous challenges raised when trying to create pervasive games that are to be used by large amounts of players. New technology which brings all the devices together in one personal device is helping this situation, but there are still challenges to be solved. Previously, experiments have been done with players carrying around a laptop computer in their backpack and so on. In order to make pervasive games a massive success however, one should strive to limit the game to handheld devices, preferably devices that are already common to ordinary people. This might be different for event based gaming, where the player could lend a device, due to the controlled environment in which the game is happening.

Capra et al.[5] have looked at some of the pervasive game concepts out there, and identified some of the difficulties that needs to be addressed when developing and scaling up pervasive games. One of the main issues is the accuracy of wifi- and GPS technology to find locations, as of today, these technologies are not accurate enough for many pervasive appliances. This really depends on where the game is played, different technologies are suitable indoor and outdoor. For example, GPS is good for outdoors use, but not indoors. Chend et al. have studied Wifi-localization using the Place Lab¹ software finding that wifi could get accuracy down to between 13 and 20 meters in dense urban areas (less in lesser dense areas due to a lower amount of access points)[6].

In many game concepts, players are out in the streets of a city with a handheld device playing with other players. One issue is connectivity, what happens when one of the players loose their connection? Earlier we stated that one should use small handheld devices for pervasive games. With these kinds of devices, there are obviously great restrictions on screen size, and therefore it is a challenge to design multimedia interfaces on these devices.

With the up scaling of pervasive games, one also have a set of issues related to resources. In many games, the hosts have to configure the game session for the area that are to be used, and reset the game when players are starting a new session. Basically, one must often reconfigure the game when a session is to take place. For a large scale pervasive game, this maintenance will require large amounts of human resources.

In the definition of pervasive games, we stated that a pervasive game could be a game with elements that change the game based on where the players are located, what they are doing and even how they are feeling. The latter is obviously a great challenge when it comes to technology. Ermi et al. have looked at players emotions during a pervasive game test session[8], but this was reported using forms and interviews.

In this section we have only looked at the challenges to be resolved by pervasive games from an engineering point of view, but there are also numerous other challenges of a more social playability and acceptance character. Niemi

¹Placelab is software providing positioning based on GPS and/or beacon positioning, enabling the use of several different technologies as radio beacons, like Wifi access points, fixed bluetooth devices and GSM towers. [HTTP://www.placelab.org](http://www.placelab.org).

et al. have looked at involving non-players in the game[27], like the NPC² in regular computer games. The report looks at the acceptance level among both players and non players, and for different age groups and gender finding that anonymity, accountability and informed consent is important. Social interactions in a game situation were studied in a game case by Jegers et al.[25], discovering that players used existing social connections over new ones (possibly due to lack of features in the test game).

²Wikipedia: A non-player character, often shortened to NPC, is a character that is controlled by the game master in role-playing games. When this definition extends to video games, an NPC in a video game is usually part of the program, and not controlled by a human.

Market Investigation

In order to be able to find out what pervasive elements people would respond well to in mobile applications it is favorable to first know what types of mobile games are popular today. To do this, we underwent a simple market analysis where we explored the games that are currently being sold, looking for some chosen parameters. This method produced a good pointer as to what is currently being developed and used out in the market today. This method is simplified, and does not account for differences in other game elements or differences in gameplay itself, it is meant only as a pointer to what.

However, a popular game is not popular only due to the game concept or the game elements itself. Other factors as marketing, publishers reputation etc, have to be taken into account.

A prerequisite for this method is having a reliable source for sales numbers and a good selection of developed games to pick from analyzing trends.

5.1 Marketplaces for mobile applications

Two of the most popular market places for games were chosen to elaborate on the games available today. The iPhone and the Android operating systems are currently among the most popular operating systems for smart phones. Both of these operating systems have their own market places for games. A market place is basically where users can buy and download games and applications directly to their devices. Some applications costs money, some does not.

Both the market places gives information on what applications are most popular, and is very suitable for surveying the current status of games on these mobile platforms.

The next two sections gives some background information on both the iPhone App Store and the Android Market.

5.1.1 iPhone App Store



The App Store is a web shop and an application from Apple, available on both the iPhone and the iPod Touch, released in June 2008. In the App Store, developers can release their applications with a chosen price, where 70% of the income comes back to the developer. Developers may also choose to release their applications for free.

Currently (8th of March 2010), the App store have over 150 000 available applications in the store. Downloads are in the billions.

5.1.2 Android Market



Android Market is an online software store developed by Google for Android devices. An app called "Market" is pre-installed on some Android devices and allows users to browse and download applications published by third-party developers, hosted on Android Market. The website itself, rather

than the Market app, only provides details of a very limited subset of available apps in terms of those that are termed "Featured", "Top Paid" and "Top Free"

5.2 Top selling applications

One important part of this study is to look at what types of games are currently being sold for mobile devices today. We chose to take two "snapshots" of the top 50 applications for Google Market and Apple's AppStore, the two major marketplaces for mobile applications today. Though the rankings on both these services change from day to day, a "snapshot" is able to tell us of what trends exist in the market at that time. A more elaborate study, tracking sales curves of applications over time, and taking into account the total gross of applications would make us able to say with more certainty what types of games would be more probable to succeed in the global marketplace, but is impractical with our time limits and budget. We will, however, be able to see what types of games are popular, and what differences there may be between the platforms.

The snapshot of the AppStore was taken using the Norwegian AppStore, while the Google Market snapshot data is global. The average price of the AppStore top 50 games was 19.08 NOK, and (calculated with currency exchange from USD, EUR and GBP 8.3.2010) the Google Market average price of the top 50 games was 19.06 NOK.

The pervasive and social elements of the games were of particular interest, but we also looked at genre and whether or not they were made in 3D.

5.2.1 The AppStore

AppStore sells apps for the iPhone, iPad and iPod touch devices.

Social elements

At AppStore, 32 out of the 50 games had social elements. 25 had online score or achievements lists. Two games had level editors with the option to share levels online with others. One game had youtube integration, enabling the user to post gameplay videos from gaming sessions to youtube.

From this, we can derive that social elements is a major selling point of mobile games. Especially online scores lists either via a master server, or via social services like Facebook or Twitter are very popular.

Multiplayer

On AppStore, 18 games had multiplayer in some way, where 3 of the games had single device multiplayer only and 4 games had asynchronous multiplayer. 11 had true real time multiplayer on different devices.

As a sub genre of social elements, it is not as popular as the online score lists, but still very prominent. Implementing multiplayer functionality (especially for network play) is more laborious than adding facebook/twitter integration. This may be a reason why multiplayer is not as prominent online highscorelists. It may also change gameplay greatly, and has to be taken into account in the game design early on.

Pervasive elements

There were two games with pervasive elements on the AppStore top 50 list. The first game, X Games SnoCross from ESPN Inc. utilized weather data and presented real world news in game.

Graphics

10% of the games were made in 3D, and some of those were not made in full 3D, being 3D renderings of a games where the movement only occur in 2D. It is clear that 3D is not yet a mandatory game feature of mobile device games like it has become on stationary devices. It may be a combination of the limited hardware on mobile devices and the added production cost of 3D games.

Genres

On the AppStore, Action and puzzle games are most popular, with 11 and 9 occurrences on the top list. Sport and Racing come at a close shared 3rd place with 6 occurrences.

5.2.2 Google Market

Google Market sells apps for the Android platform, which is used by multiple devices, including Google NexusOne, HTC Hero and Motorla Droid.

Social elements

20 of the games on Google Market had social elements of one type or another. 11 of these were online score lists. 12 games had multiplayer. Two games had in game communication with other players.

On Google Market, online high score lists and multiplayer are roughly equally represented, with respectively 12 and 11 occurrences on the top 50 list.

Pervasive elements

As with the AppStore, pervasive elements are not greatly represented in the top 50 list. On the list there was a single game using location based high score lists.

Graphics

Only a single game out of fifty was rendered in 3D.

Genres

The genres are much the same as on the AppStore. Like on AppStore the Action genre is on first place with 11 occurrences, but on Google Market Sports has taken the 2nd place with 7 occurrences. Puzzle games follow with a close 6 occurrences. As we have not tracked changes over time, these numbers may not be completely accurate, they might be unstable. Still, we can see the tendencies on Google Market are much the same as on the AppStore. One discrepancy between the two stores is the Emulator genre. On Google Market it ranks as the 4th genre, while it is virtually nonexistent on the AppStore. This may be due to Apple's strict application approval process.

5.2.3 Comparison

Google Market and the Apple AppStore show roughly the same tendencies, with Action, Puzzle and Sports games being most popular. Few games on the top 50 list have pervasive elements. Social elements like facebook and twitter integration and multiplayer functionality is much used on both marketplaces. 3D games are more prominent on AppStore than on Google Market. This may be because AppStore presently has more apps, more customers and therefore more competition. 3D games are more expensive and complicated to make than 2D games, but might make users choose one game over another in a crowded marketplace.

5.3 Other applications of interest

There are not many commercial pervasive games available today. However, we have identified three location based games which are being sold today, as well as one free game which might be noteworthy.

5.3.1 Turf Wars

One of the most note worthy are *Turf Wars* by MeanFreePath. In turfwar you play a Mafia boss who can set up his own “turfs” as well as attack other mobsters and do missions. Missions and attacking other mobsters earn you experience points and money. You also earn money from turfs, in addition to influence. Money is spent on upgrading and adding turfs, buying weapons and regaining health. Turfs can only be placed near your real world location. Users can capture nearby turfs by attacking them. The gameplay distinguishes itself from other mafia style games like *iMafia*, *iMobsters* and *Mafia Wars* by this use of location based technology. The use of location based technology makes the game dependent on having other geographically nearby players, but offers a completely different play style and depth of gameplay. Like other games in the mafia sub genre, *Turf Wars* is released as a free application where you may purchase in game currency with real world money. The interchangeable in game currency of *Turf Wars* is *Respect points*. *Respect points* may be used to purchase in game \$ (for upgrades, weapons etc), henchmen (non player mob members), health, stamina, energy or other in game attributes. *Turf Wars* is available for the iPhone only.

5.3.2 Parallel Kingdom: Age of Emergence

Another pervasive game for both the iPhone and Android platforms is the fantasy RPG *Parallel Kingdom: Age of Emergence*. Like *Turf Wars*, *Parallel Kingdom* uses a business model where the game is downloadable for free, but offers an in game currency which can be bought for real world money. The in game currency of *Parallel Kingdom* is food. Food can be used to acquire skill points, refine oil, training your hunting dog et cetera. The gameplay centers around your geographical location. When you start the game, you may move around in an area centered on your geographical location. Monsters, items and objects are seeded to different geographical locations. Monsters may also move around in the world. In addition to monsters and game objects, other players and their property can also be seen in the game world. Players are visible only when playing, but their property is stationary, and can be attacked even when they are not online. The object of the game is to slay monsters, level up, and to build your own kingdom by setting up flags and building structures. Structures are made by gathering the required resources, and selecting an empty spot to

build on. Most structures can only be placed inside the players own territory. Territory is captured by planting flags. Planting a flag captures an area around it for the user that planted it. The user can also travel to any flag he has previously set up, and move around in the area around that flag as he would normally do around his geographical location. To see new locations, the user can also use his hunting dog. By using some resources, he can have the dog lead him to new territory, typically an empty area near the geographical location of the user, but outside his are of influence. The user may pick up items, build structures or engage monsters just as he would be able to in his geographical vicinity. It is also possible to craft items using gathered resources.

5.3.3 Traveler's Quest

Traveler's Quest by Kitty Code, LCC is a family oriented game resembling geocaching. Unlike geocaching, however, there are no physical objects involved. The gameplay of *Traveler's Quest* revolves around creating, selling and purchasing treasure maps, and then using them to hunt for treasure. Discovering treasure and creating/selling treasure maps gains the user in game currency he can then use to buy more maps. The in game map shows the users location, as well as the treasure's location and the users distance from the treasure. The object is then to move around in the real world until the user is near enough to retrieve the treasure. The treasure can then be buried somewhere else, earning the player money while it is buried. The amount of money gained by the treasure depends on how far away from the treasure's origin you have buried it. Other players may also be able to find the treasure without a map, if they pass close enough to it. The game has a purchase price of 17 NOK, and no purchasable in game currency.

5.3.4 Killer

Killer is an iPhone only game where users hunt each other, and try to "shoot" each other in a virtual world. To "shoot" another player, the player has to get into bluetooth range of the other player, and initiate a "shot". The other user would then try to get out of bluetooth range of the initiator and then answer the "shot". If he cannot get out of bluetooth range, or if he does not answer

the shot, he is then “killed” in game. If the initiator winds, he gains the points of the player he “killed”, and the other player loses all points. *Killer* is not at the moment a commercial game, since it neither costs money or sells in game currency, but is included in this list as it still is noteworthy.

5.3.5 Foursquare and Gowalla

Foursquare and Gowalla are location based services which combine information about places of interest, and let's the user track visits to these locations. Although they are not games, they are of interest for this project as they represent more general uses of location based technology. Integrated to services like Twitter and Facebook, these application change the way people meet up by having users announce to their friends where they are and what they are doing. In addition, foursquare has to do-lists and Gowalla has tours, which both encourage users to share favorite locations.

5.4 Conclusion

There are some pervasive games on the AppStore and Google Market today. While they are not yet very common, there is a growing interest in location based games. Other pervasive elements may also give added value to games, such as with the real time weather data in the ESPN game *X Games SnoCross*. The games we see today have not yet reached critical mass, or come into the public eye, but the fact that they do survive today indicates there is a community forming around these games, where players do play these games over long periods, or at least there are enough new adapters to keep the user base growing. Pervasive games have been around for some time, but have not had a commercially available platform before the iPhone 3G was introduced in 2008. Today pervasive games can be implemented both on the iPhone and Android platform, creating an even larger user base. One of the main issues of location based games is still the need of local users. Much of the gameplay of location based games depend on other players being in the same general area at some time or another during the game. Thus, location based games are much more lightly to become popular in densely populated areas like large cities, where there is a chance of finding other users. There are many pervasive game

concepts that do not have these limitations, but these have not been prominent on either store as of now.

Related work

Work of similar character have been performed before. Several researchers have performed surveys targeting game players. Most of them however, have another main focus and goal than our research. Many of these projects have a basis in a research field different from computer engineering.

Researching sex differences in gameplay, Lucas and Sherry performed a survey on young men and women [26]. Based on the respondents to their survey, they found that there are differences in sexes when it comes to gaming. They posted several different hypothesis regarding male and female game playing. From their results, one can see that among the respondents, 54.6% of young women and 88.3% of young males were players. Further on, the game session length for male was a mean of 11 hours per week, and 4.25 hours for females. They also did some research into motivations for playing, but the results mentioned here are the most interesting for our research.

Focusing on how players adopt to Mobile Broadband Wireless Access technology-based (MBWA) games, and trying to explain developers how to increase ac-

ceptance, Ha et al. have conducted a survey on different parameters that are considered important [23]. They used an extended version of the technology acceptance model (TAM)¹. The main results and suggestions for developers are to focus on creative and solid story lines, maximizing simplicity in using the game. Ease of use was also more important for older individuals and females.

Investigating interactive in-game advertising, Dr. Barry Ip conducted a questionnaire on both industry experts and gamers [24]. The results from the project suggests that gamers are generally reporting a positive attitude towards the use of interactive advertising, but that they might not be conscious of the presence of such advertising and that the games appeal is not increased significantly by advertising in-game. However, for our project, the methodology of this project is more important than the results. They used university students, games retailers and student from local schools as subjects for the questionnaire. They also used Internet-based forums for hardcore gamers. Their questionnaire methodology is very similar to the one we plan to conduct.

Examining the links between childhood obesity, activity participation and television and video game use in a sample of children (2831) ages 1–12, Vandewater et al. found that while television was not related to children’s weight, video game usage was [32]. Their goal was different from hours, but based on their survey data, one can see that there are, not surprisingly, great differences in electronic game use between young males and females. For children between 9 and 12, girls used a mean of 17.65 minutes on games over a two day period, while males used a mean of 56.91 minutes. The data suggests that differences in general computer use is not that significant compared to game usage (27.17 for boys versus 15.43 for girls).

Faria et al. performed a survey of simulation game users, former users and never users [9]. The survey was performed using e-mail invitations. They used several methods for ensuring high response rates from invitees:

- ▷ *the offer of an alternative means to completing the questionnaire*
- ▷ *the offer of an incentive to respond*
- ▷ *multiple contacts.*

¹The Technology Acceptance Model (TAM) is an information systems theory that models how users come to accept and use a technology.

Their survey method suggests that multiple contacts are very effective in achieving more responses. From their first e-mail, they got 627 responses, and 198 from the second. The third gave 260 responses. Based on this, there were more than 50% increase in responses using multiple contacts. These are important numbers for our research methods. They also refer to a report from 2003, suggesting that response rates to e-mail surveys are often low and in the range of 5% to 10%.

From these research projects and reports we have learned a great deal on research methodology, analysis approaches and methods. Also, we have some game usage patterns and gamer profiles data that we could use as comparison and a basis for our research results in mobile game usage patterns.

Part III

Design of research

Research method

Previous chapters in general explain how the research method and survey design should be performed.

The research will be conducted using two surveys.

The first survey will be a general survey performed on a larger scale, helping us understand both existing gamers and potentially new gamers attitudes towards pervasive elements, how and when they play today, etc. This will be a small set of questions, and the survey should take under 10 minutes to answer in total.

In survey II, the responders will be presented with a number of cases. These cases will be game concepts with varying degrees of pervasive elements. This survey will be targeted at a smaller group of individuals, and will be more time consuming. The basis for survey II will be the results from survey I.

In this chapter we will shortly present the purpose of each survey and general information about methodology. Chapters 8 and 9 will describe in detail how the surveys are designed and distributed.

7.1 Survey I

The first objective will be to create a survey targeted at both existing and potentially new game playing individuals, at all ages. The survey will be designed to categorize different individuals based on gaming experience. The goal for this survey will be to create an understanding on gamers and non-gamers attitudes towards games, and to study usage patterns (defined in section 2.2). This will create a baseline for further investigation.

The survey will be hosted on the Internet, and participants will be invited to respond by e-mail or by forum invites, as stated in chapter 8 about survey design.

7.1.1 Challenges

We are faced with numerous challenges using this kind of method. First, the process of inviting respondents will introduce bias¹. Our goal should be to limit this bias as much as possible. Second, a good response rate² is important to limit bias. The survey design and distribution model is important in order to reduce survey error and answer distortion. A good response rate is difficult to achieve, but never the less important. There might be characteristics about the individuals that choose not to answer a survey that is actually important to the result of the survey.

More on these issues in chapter 8.

¹Bias: a systematic distortion of a statistical result due to a factor not allowed for in its derivation

²Response rate: ratio of number of people who answered the survey divided by the number of people invited

7.1.2 Counter measures

There are several important measures what could be applied to achieve a good response rate. First, the design of the actual survey is crucial. It must be easy to read while not being condescending. Questions should be closed with a predefined set of possible answers. They should also be unambiguous.

Testing must be performed to ensure that responders have the correct understanding of the proposed questions. This part could be performed on any part of the population.

Traditionally, prizes are used to get individuals to respond to surveys. This may of course introduce bias as well. Using prizes will motivate subjects to respond, but may also create bias due to people only answering because they want the prize, thus not actually using a sufficient amount of time to answer. However, we believe that this is a good trade off in order to get a good number of respondents to our survey.

7.2 Survey II

The objective of the second survey is to gather further insight into what types of pervasive game elements people are likely to enjoy. This survey will use the information from the first survey to select a representative selection of subjects for further study. Since the second survey will be more elaborate, less people are likely to be responding.

Once a proper sample population is established, we will present a series of game concepts to the subjects, which they in turn will rate for different attributes. The main attributes of interest are: Is the game concept compelling? How interesting would it be to play the game against other players? How interesting would it be to play in teams against other teams? How interesting would it be to play the game as an in a event based scenario? All these attributes should be rated on a fixed scale. The survey will be implemented as an extended online survey.

7.2.1 Challenges

As with the first survey (or surveys in general), bias is a problem. But, since we use the first survey as a basis for choosing the sample population, the possibilities of bias will be reduced (or brought along from survey I). Choosing the right sample population from the population of the first survey would be important to reduce bias. Response rates might be improved by using a sub population from the first survey. One could even ask if the responder in the first survey would be interested in participating in the second survey at the end of the first, and then select a balanced sub population from these responders to be in the second.



Survey design

One of the first questions that arises when a computer engineer is about to make a survey is: how does one create a survey that is good for both respondents and researchers?

With very limited knowledge about this field, however assuming an approach where we make up questions we feel like asking is wrong, we chose to study some literature before starting the work on creating surveys.

There are really three parts to a survey. The first part is designing the survey, second part is distributing and deploying the survey and the third part is analyzing the results. The first part is covered by a book written by Fowler that focus on how to develop and evaluate the actual survey and it's questions [15]. Part two and three are covered by two books explaining methodology and evaluation by Fowler [11] and Robson [29].

8.1 Survey design

As stated by Fowler [16] designing a survey is not about creating some questions based on a wish to extract information using a survey. To design good questions, it is important to base this on what information is actually needed, what we are trying to find out. One does need a set of objectives before creating questions. What Fowler defines as a good question is stated in section 8.2.

The initial task when designing a survey should be to find a purpose for the survey. What are we going to study? Then one should setup some objectives to achieve this goal, and later extract the actual questions from these objectives. The purpose of the survey and objectives makes an outline of the survey content. This outline helps specify goals for each question, and helps finding questions that should not be asked. For example, if the researcher cannot find a matching objective for a question, that question might be without a clear purpose.

8.2 The good question

Fowler states [17] that a question and its answer have five basic characteristics that are important to facilitate a good survey process:

1. *Questions need to be consistently understood*
2. *Questions need to be consistently administered or communicated to respondents*
3. *What constitutes an adequate answer should be consistently communicated*
4. *Unless measuring knowledge is the goal of the questions, all respondents should have access to the information needed to answer the question accurately*
5. *Respondents must be willing to provide the answers called for in the question*

There are several methods suggested for evaluating to what degree a question fulfills these characteristics. The one we are going to use is field pretests. This part is described in section 8.3.

From the list above, characteristic one is achieved by making sure that all the respondents have the same understand to what should be answered. All definitions should be the same for all the respondents. This means that definitions that might vary among different individuals, or that might be unclear, should be stated along with the question.

Since we plan to deploy our survey using a web based interface, characteristic number two is automatically fulfilled.

Characteristic number three is important especially for open questions¹. To make sure respondents answer in an adequate way, we will for the most part use closed questions².

For our questions, measuring knowledge is not a goal. Characteristic number four is both about the respondents knowledge level, and about memory [18]. There are several methods for making the memory recall process easier for respondents, which we will not go into depth with there. As our survey has a technical background, this part is important to have in mind when designing questions. There is probably information that is obvious to a computer engineer, but not to the average computer user.

The last characteristic is about sensitive answers. The information in our survey might not be considered sensitive by most people, but to other people it may. This is important to consider in order to avoid distortion of answers. Some of the answers might be considered socially undesirable. Fowler states that there are a few key messages that need to be communicated in order to avoid distortion [19]:

▷ *Ensure and communicate to respondents the confidentiality of the answers*

¹Open question: A question where the respondent is free to answer whatever he or she wants in plain text.

²Closed question: A question where respondents are limited to a predefined selection of answers.

- ▷ *Make clear to respondents that being accurate is more important than self-image*
- ▷ *Design questions to minimize the likelihood that respondents will feel their answers will be put in negatively valued categories*

The main goal for our design is obviously to reduce survey error. It is important to ask people about their firsthand experiences, not to rely on secondhand information. Secondhand information may not be available to the respondent, or available information might be inaccurate. Asking hypothetical questions or asking about solutions to complex problems is not acceptable. Wording is also important to make sure that every respondent have the same understanding of the question. Words must be chosen carefully, and definitions should be provided with the question if some things might be unclear for respondents.

For an interview based survey, respondent training is important. This will ensure that everyone proceeds in the same manner. For a Internet based survey like ours, we must rely on written instructions. Respondents are often not willing to read detailed instructions, so this should be kept to an absolute minimum.

To conclude on the design of a good question, Fowler have stated a few key principles in which we will follow in our design process [20]:

1. *Avoid ambiguous words: define the key terms in questions*
2. *Minimize the difficulty of the recall and reporting tasks given to respondents*
3. *For objectives that pose special definitional or are recall challenges, use multiple questions*
4. *Give respondents help with recall and placing events in time by encouraging the use of association and other memory aids*
5. *Make sure the form of the answer to be given fits the reality to be described*
6. *Design all aspects of the data collection to minimize the possibility that any respondent will feel his or hers interests will be best served by giving an inaccurate answer to a question*

8.3 Pretests

The use of pretests is essential in ensuring the quality of the survey and its questions. Out of several different methods for survey testing, we will perform a modified field pretest. The goal for such a test is to evaluate the overall survey, survey length and especially the questions. As stated earlier, it is important that the respondents have the same understanding of the question as the researchers. This will be explored in a pretest. We will extract information on survey length and readability, to see if there are possible improvements in these areas.

The testing will be sending the survey to between 20 and 30 respondents. Each of them will be presented with the survey with open questions instead of the closed ones we plan to deploy in the final edition. The reason for this is to check our questions for inaccuracy in wording and the way the questions is presented. By analyzing the answers we will get an understanding of how respondents understand and read each question compared to our set of pre-defined answers.

As suggested by Fowler [21], each test respondent will also be presented with a couple of debriefing questions. Respondents will be asked to identify any questions that they found confusing, that they had problems answering or other reasons for problems answering the survey.

This test method is not optimal, as actual interviews would give even more value. However, we believe that this is a good trade-off between information extracted and resources, and it will help us identify many issues and possible errors in the survey.

8.4 Conducting surveys (samples and sample frame)

The purpose of surveys is to produce statistics for analysis. The analysis cannot be any more precise than the data it is based on, which means the data collected must be as precise as possible. Data is collected by asking questions to subjects. However, since a complete census is impractical (asking each individual in a population is expensive and time consuming), data is only collected from a fraction of the population. For the data collected to be applicable for the whole

population, the individuals asked have to be representative for the population as a whole. Sampling methods are used to make sure the chosen individuals are representative.

8.4.1 Who to question?

From the problem definition, we derive three areas we want to enlighten:

- ▷ The usage patterns of traditional games today
- ▷ The usage patterns of games on portable devices
- ▷ The potential of pervasive games and pervasive elements in games

To describe the usage patterns of traditional games, we should look at what the usage patterns of people who play games today are. This could be people who play traditional games or mobile games. For traditional games, we could limit the population in question to people who are known to play games. For mobile games, however, it could be useful to look at the usage patterns of people who do not consider themselves as “gamers”. When looking at the potential of pervasive games, it could be interesting to capture the opinions of both traditional gamers and non-gamers to look at the differences in their preferences.

The challenge of finding who to include in the survey is a balance between the ideal and the possible. Ideally we would like to question the whole population (all Norwegians, all Europeans or even everyone on Earth). This is not practically possible, so we need to limit our scope somewhat. There are some channels we have identified which we could utilize to reach potential subjects. They all have sets of potentially biasing factors.

Firstly, we could address forum users on Internet gaming sites or portals. This would limit the population to people who are very interested in games and who regularly check gaming forums or blogs, but these people would also be more inclined to answer questions from a game usage survey. From these we would probably get a good response rate, could only say anything about gamers and very game interested subjects.

Secondly, we could address users of non-gaming Internet forums, which may give us a broader set of subjects in the population. The population would still be limited to people who are above average interested in it, and regularly check forums.

Thirdly, we could address members of the NTNU (Norwegian University of Science and Technology) mailing list. This would limit our population to students at NTNU who regularly check their email. NTNU students are generally highly educated young individuals, two great biasing factors.

At last, we could use a mailing list we have access to from Apps AS (iPhone application developer company). This mailing list consists of people who have purchased an iPhone app from Apps AS, or downloaded the free yr.no application. This population would be biased to people who own, or have owned an iPhone, most would pay for mobile applications and they all use mobile applications.

All these options have introduce biases, and none of them makes us able to talk about the general population. We could, however collect data from two or more of these sources, and compare them. It would still not make us able to extrapolate this to the general population, but it would make us able to describe the differences between the populations.

8.4.2 Selecting samples

A sample is a number of individuals from the population. To make the sample representative of the population in question, all members of the population should have an equal (or at least known) chance to be included in the sample. For example, if a complete list of the population exists, where every member of the population exists once and only once, one could pick subjects for the sample randomly. If, however, some members of the population have a greater chance of being chosen than others (exist multiple times in the list), their data might be weighted. If for example we know an individual exists twice in the list, the probability of selecting that individual is twice as much as the others. The data from this individual should then only be included with half weight in the data set for analysis.

Fowler[12] describes some critical issues which must be taken to account when selecting samples for a survey:

- ▷ *the choice of whether or not to use a probability sample*
- ▷ *the sample frame (those people who actually have a chance to be sampled)*
- ▷ *the size of the sample*
- ▷ *the sample design (the particular strategy used for sampling people or households)*
- ▷ *the rate of response (the percentage of those sampled for whom data are actually collected)*

Fowler states that the quality of the data can be no better than the most error prone feature of the survey design. Best practice requires examination of all the above design features.

8.4.3 The sample frame

A sample can only be representative for its sample frame. Probability sample procedures may be used to designate individual units for inclusion in a sample.

Fowler describes three general classes of sampling schemes[13]:

1. *Sampling is done from a more or less complete list of individuals in the population to be studied.*
2. *Sampling is done from a set of people who go somewhere or do something that enables them to be sampled (e.g patients who received medical care from a physician, or people who attended a meeting). In these cases, there is not an advance list from which sampling occurs: the creation of the list and process of sampling occur simultaneously.*

3. *Sampling is done in two or more stages, with the first stage involving sampling something other than the individuals finally to be selected. In one or more steps, these primary units are sampled, and eventually a list of individuals (or other sampling units) is created, from which a final sample selection is made. One of the most common such sampling schemes is to select housing units, with no prior information about who lives there, as a first stage of selecting a sample of people living in those housing units.*

He also describes the key characteristics of a sample frame relevant for the precision of the survey:

- ▷ *Comprehensiveness* - a sample can only be representative of the sample frame
- ▷ *Probability of selection* - is it possible to calculate the probability of selection of each person sampled?
- ▷ *Efficiency* - sample frames may include units that are not among those which the researcher wants to sample.

For any survey, sampling from a complete list of individuals is preferable, but not always possible. If one such list exists, it should be used. The second class may be the easiest method to use, but since the sample frame would consist only of the people who enable themselves to be sampled, the survey could not say anything about anyone else. The third class is applicable for a population who are distributed among different lists to be collated.

The same is true for our own survey. A complete list of individuals would be preferred, but may not be possible due to time and funding constraints. As mentioned earlier, we have limited resources, and therefore limited options when it comes to contacting possible survey subjects. We are therefore limited to the second class of sampling, sampling from people who go somewhere or do something that enables them to be sampled. The main problem with this type of sampling is that we are then unable to calculate the sampling error. This could lead to bias because the people who enable themselves to be sampled may be different from the people we are not able to sample. It is, however a

much easier and cheaper way of sampling, and with our budget constraints it is the only feasible solution.

The sampling method would have the following characteristics:

- ▷ **Comprehensiveness:** For our survey, the sample would be representative for the people who read the email sent out, or who entered the portal/website where the survey was posted.
- ▷ **Probability of selection:** The probability of each subject being sampled would be dependent on the willingness of the person in question to undertake the survey. The probability of selection would therefore not be determinable.
- ▷ **Efficiency:** The sample frame would only include units of interest, so efficiency is good.

8.4.4 Strategies of selection

Fowler describes these selection strategies:

- ▷ Random selection - from a complete list of subjects in the sample frame, select sample randomly
- ▷ Systematic - from a complete list of subjects in the sample frame, start at random position, select the rest of the samples by a predetermined pattern (for example, every 10th person after the initial value). This strategy may be vulnerable to any system in the data (the order of subjects in the list must be arbitrary, if every 10th person would be chosen from a list ordered with every other person being male and female, one would end up with all samples being of one gender).
- ▷ Stratified - select samples from subgroups to represent the total population. With this strategy, we use knowledge we have of the subjects in advance to determine who should be sampled by matching the ratios of classes of people in the sample to the ratios of the sample frame. This could also be done along with weighting to get better accuracy for

minorities in the sample frame. (for example, by doubling the samples taken from a determinable sub population, but halving the weight of their data. This would account for a bigger register of collected data, while not greatly influencing the number of samples taken). Can also be used for multistage sampling.

In our survey, we would try to get all possible subjects to answer, and will not use any selection strategy (as we are using Fowler's second class of sampling schemes).

8.5 Sampling error

The main reason for using sampling strategies is to be able to describe the potential sampling error of the scheme. When using probability or stratified sampling it is relatively easy to calculate the suspected sampling error. However, due to our sampling strategy in this project, we are unable to calculate the sampling error. This is a trade off of the "convenience" method of sampling. Fowler describes calculation of sampling errors in his book.[14]

Survey I: Detailed Design

In order to fully describe each survey and their design, we write about how the survey is created. This also includes an explanation about each question, what is the goal, etc.

In the previous chapter we have written about how a survey should be designed, and what is important designing questions. Here we describe the results from the study of survey methodology, specifically for survey I.

Read on to find information such as questions with pre-defined answers and survey test results. Remember the focus area of this survey: to find out more about usage patterns for games on portable devices.

9.1 Survey outline and question objectives

This section is a part of the survey design process. The goal is to form a set of objectives, in which we will extract our actual survey questions from.

Purpose of survey: The purpose of the survey is to study usage patterns in mobile games, game habits and attitudes towards pervasive games. These objectives are important for this purpose:

- ▷ Personal information that is relevant for the respondents game usage and knowledge level
 - ▷ age
 - ▷ social status
 - ▷ income
 - ▷ education
 - ▷ other spare time activities/interests
 - ▷ gender
 - ▷ location
- ▷ Game usage
 - ▷ context (time of day, week, main or secondary activity)
 - ▷ how much time the player use for gaming
 - ▷ gaming frequency
 - ▷ social context
 - ▷ platform (mobile, stationary, etc)
- ▷ Pervasive game usage
 - ▷ Location based games
 - ▷ Interest for concept

From these objectives, we will extract the actual survey questions (outlined in the next section).

9.2 Survey questions

This section lists all the questions in survey I, including pre-defined answers and the objective for each question. Each question is also given a number, which is later referred to in the results section. Part a for each question describes the alternatives given to respondents, while part b explains the objective for the question (reason for asking).

1. What is your age?
 - a) 10 - 19, 20 - 29, 30 - 39, 40 - 49, 50 - 59, Over 60
 - b) Extract personal information to form a respondent profile
2. What is your gender?
 - a) Male, female
 - b) Extract personal information to form a respondent profile
3. What is your zip-code?
 - a) -
 - b) Extract personal information to form a respondent profile
4. What is your social status?
 - a) Single, in a relationship, cohabitant, married
 - b) Extract personal information to form a respondent profile
5. What is your approximate monthly income before tax?
 - a) 0 - 9999 kr, 10000 - 19999 kr, 20000 - 29999 kr, 30999 - 39999 kr, Over 40000 kr, do not wish to answer
 - b) Extract personal information to form a respondent profile
6. What is your highest achieved education level?
 - a) Primary school, high school, university/college

- b) Extract personal information to form a respondent profile
7. Are you currently under education?
- a) Yes, no
 - b) Extract personal information to form a respondent profile
8. What is your main spare time activities?
- a) Sports, TV / movies, video games, board games, outdoor life, music, books, other: please specify
 - b) Extract personal information to form a respondent profile
9. Approx, how much time do you spend on your spare time activities from question 8?
- a) Below 10 hours, 11 - 20 hours, 21 - 30 hours, 31 - 40 hours, Over 40 hours
 - b) Extract personal information to form a respondent profile
10. Do you play games on computers or game consoles? Console: Xbox, PlayStation, Wii, and similar.
- a) Yes, no
 - b) Game usage, logic question. If user answers no, he will not be asked more questions about game usage on computers or game consoles
11. Do you play games on mobile devices? Mobile device: cellular phone, Sony PSP, Nintendo DS, and similar.
- a) Yes, no
 - b) Game usage, logic question. If user answers no, he will not be asked more questions about game usage on computers or game consoles
12. For consoles or computers: Approximately how many game sessions do you play in an average week (Monday to Thursday)?
- a) None, 1 - 3, 4 - 6, 7 - 9, 10 - 15, 16 - 20, Over 20

- b) Game usage, objective is to find game session frequency on weekdays.
13. For consoles or computers: Approx how many game sessions do you play in an average weekend (Friday to Sunday)?
- a) None, 1 - 3, 4 - 6, 7 - 9, 10 - 15, 16 - 20, Over 20
- b) Game usage, objective is to find game session frequency in weekends.
14. For consoles or computers: Approx, what is the length of your game sessions in an average week (Monday to Thursday)?
- a) 0 - 5 min, 6 - 15 min, 16 - 29 min, 30 - 59 min, 1 - 2 hrs, 2 - 4 hrs, over 4 hrs
- b) Game usage, objective is to find game session length on weekdays.
15. For consoles or computers: Approx, what is the length of your game sessions in an average weekend (Friday to Sunday)?
- a) 0 - 5 min, 6 - 15 min, 16 - 29 min, 30 - 59 min, 1 - 2 hrs, 2 - 4 hrs, over 4 hrs
- b) Game usage, objective is to find game session length in weekends.
16. For consoles or computers: in percent, approx how many of your game sessions is performed in parallel with another activity (ex: watching TV, waiting for the bus, cooking, working and similar)?
- a) Never, 1% - 20 %, 21% - 40%, 41% - 60%, 61% - 80%, 81 % - 100%
- b) Game usage, objective is to find out if playing is a result of another activity.
17. For consoles or computers: On a scale from 1 to 5, how are these reasons for gaming relevant to you?
- a) Relax, social, competitive, time consume, addiction, entertainment
- b) Game usage, objective is to find reasons for playing games
18. Do you have any other reasons for playing games?

- a) -
 - b) Game usage, objective is to find reasons for playing games
19. For consoles or computers: in percent, approx how many of your game sessions are played with another person?
- a) Never, 1% - 20 %, 21% - 40%, 41% - 60%, 61% - 80%, 81 % - 100%
 - b) Game usage, objective is to investigate multiplayer usage for comparison with portable devices.
20. For consoles or computers: in percent, when you play with others, how often are you located at the same place?
- a) Never, 1% - 20 %, 21% - 40%, 41% - 60%, 61% - 80%, 81 % - 100%
 - b) Game usage, objective is to investigate multiplayer usage for comparison with portable devices.
21. For consoles or computers: in percent, when you play with others, how often do you play on the same device?
- a) Never, 1% - 20 %, 21% - 40%, 41% - 60%, 61% - 80%, 81 % - 100%
 - b) Game usage, objective is to investigate multiplayer usage for comparison with portable devices.
22. For portable devices: Approximately how many game sessions do you play in an average week (Monday to Thursday)?
- a) None, 0 - 10, 11 - 20, 21 - 30, over 30
 - b) Game usage, objective is to find game session frequency on weekdays.
23. For portable devices: Approx how many game sessions do you play in an average weekend (Friday to Sunday)?
- a) None, 0 - 10, 11 - 20, 21 - 30, over 30
 - b) Game usage, objective is to find game session frequency in weekends.
24. For portable devices: Approx, what is the length of your game sessions in an average week (Monday to Thursday)?

-
- a) 0 - 5 min, 6 - 15 min, 16 - 29 min, 30 - 59 min, 1 - 2 hrs, 2 - 4 hrs, over 4 hrs
- b) Game usage, objective is to find game session length on weekdays.
25. For portable devices: Approx, what is the length of your game sessions in an average weekend (Friday to Sunday)?
- a) 0 - 5 min, 6 - 15 min, 16 - 29 min, 30 - 59 min, 1 - 2 hrs, 2 - 4 hrs, over 4 hrs
- b) Game usage, objective is to find game session length in weekends.
26. For portable devices: in percent, approx how many of your game sessions is performed in parallel with another activity (ex: watching TV, waiting for the bus, cooking, working and similar)?
- a) Never, 1% - 20 %, 21% - 40%, 41% - 60%, 61% - 80%, 81 % - 100%
- b) Game usage, objective is to find out if playing is a result of another activity.
27. For portable devices: On a scale from 1 to 5, how are these reasons for gaming relevant to you?
- a) Relax, social, competitive, time consume, addiction, entertainment
- b) Game usage, objective is to find reasons for playing games
28. Do you have any other reasons for playing games?
- a) -
- b) Game usage, objective is to find reasons for playing games
29. For portable devices: in percent, approx how many of your game sessions are played with another person?
- a) Never, 1% - 20 %, 21% - 40%, 41% - 60%, 61% - 80%, 81 % - 100%
- b) Game usage, objective is to investigate multiplayer usage for comparison with portable devices.
30. For portable devices: in percent, when you play with others, how often are you located at the same place?

-
- a) Never, 1% - 20 %, 21% - 40%, 41% - 60%, 61% - 80%, 81 % - 100%
 - b) Game usage, objective is to investigate multiplayer usage for comparison with stationary devices.
31. For portable devices: in percent, when you play with others, how often do you play on the same device?
- a) Never, 1% - 20 %, 21% - 40%, 41% - 60%, 61% - 80%, 81 % - 100%
 - b) Game usage, objective is to investigate multiplayer usage for comparison with stationary devices.
32. Have you ever played a game in which utilizes your geographical location as a game element? Example: A game that requires that you are present in a given location to perform an activity, or where your location is decisive for the game experience or game progress?
- a) Yes, no, provide additional information (optional)
 - b) Pervasive game usage, objective is to find the current status of some pervasive game elements.
33. Have you ever played a game which in another way use information about the real world to change the game progress or experience? We are looking for a game in which mixes real- and virtual world elements. Examples: Weather data from the real world is reflected in the game, the game is affected by factors outside the game itself: Internet web pages, forums, and similar.
- a) Yes, no, provide additional information (optional)
 - b) Pervasive game usage, objective is to find the current status for pervasive games usage.
34. How would these kinds of elements change the value of the game for you?
- a) Very negative, negative, no change, positive, very positive
 - b) Pervasive game usage, objective is to find new and existing players attitudes towards pervasive game elements and how they see this value.

35. Do you have any comments on this questionnaire or additional information?
- a) -
 - b) Additional information (evaluation)

9.3 Field test results

As explained in the survey methodology chapters, testing is absolutely crucial to ensure the quality of the survey and its questions. By testing, one can find problems with understanding questions, logic problems and several other issues.

Survey I went through two tests, each in which are explained in the sections following (9.3.1 and 9.3.2).

9.3.1 Test I

The first survey test leading to the final questions in the previous section was answered by a total of 25 persons with ages varying between 20 and 50. Most of the respondents were male (84%). The overall response was positive.

For most of the questions, the understanding from the respondents were good. The test not surprisingly revealed that personal income is very sensitive to some individuals, and that a final survey design should include an option for those not willing to disclose their personal income.

For the questions regarding pervasive games, we initially deployed the questions with less information and explanation. Based on this test, we found that respondents had some difficulties understanding the questions and the concepts. This led to including more information and examples with the questions.

In general, the results told us that question logic is very important, if one question is ruled out by the answer to another question - the participant should not have to answer the follow-up. It also told us that the pre-defined answers

need to be more concrete than we first anticipated. Further on, based on the feedback, we altered the question wording and formulation to be clearer for respondents.

We had initially implemented a few questions regarding game spending, how many games the respondents have bought and how much money spent. However, after initial testing and some further consideration, these questions were left out from the final design. The reason for this is that the questions are not really within our scope, and they were dropped to cut down on survey time usage.

Most of the respondents used between five and ten minutes on the survey (the test used open questions, which makes it more difficult to answer than with pre defined answers), including the survey evaluation questions. This is just within our target time for completion.

9.3.2 Test II

With the improvements from test I in place, we deployed the final survey design to ten people, to see if there were any misunderstandings or technical problems with the survey. The overall response was good, and no one seemed to have any problems with the design. From respondents that also participated in test I, the feedback was that design II was greatly improved.

The response time from subjects were reduced from 5-10 minutes to 3-6 minutes (average). This is mainly due to adding pre-defined answers and some question logic. The question logic helps reduce the number of questions that are not relevant for the respondent due to previous answers. For example, if the respondent does not play games, he or she does not have to respond to questions about game usage.

9.4 The Sources

We distributed the survey to game forums, mailing lists and blogs. Below are the different channels we used. Each channel is supplied with a small description below.

9.4.1 Gamer.no

Gamer.no is a Norwegian game blog and forum. We posted the survey in the “General game discussion” forum. At times our thread was visible from the front page of the gamer.no blog.

9.4.2 Diskusjon.no

Diskusjon.no is a general forum with connected blogs with different scopes: IT, hardware, games etc. We posted the survey in the “General game discussion” forum.

9.4.3 NetCom

NetCom is one of the leading mobile phone service providers in Norway. NetCom has an iPhone blog, where we were featured with an article about pervasive games[2]. We were also featured on the NetCom iPhone facebook page and in an email NetCom sent out to their iPhone mailing list.

9.4.4 Apps AS

Apps AS is one of the leading developers of iPhone applications in Norway. The survey was promoted in an email sent out to their mailing list.

9.4.5 NTNU

NTNU has a internal web portal for students, in which we were featured with a post linking to the survey.

Survey II: Detailed Design

This chapter is for Survey II what chapter 9 is for survey I, we write about how the survey is created and about its contents.

Each question in the survey, and the goals for the survey and how the survey is built is explained.

Read on to find information about questions and elements in survey II. The focus area of this survey is obviously more targeted at pervasive game elements, and users attitudes towards these. The plan is to to deploy the survey to respondents of survey I (to get and understand not only on attitudes towards pervasive elements, but to understand who are expressing those attitudes).

10.1 Pervasive game elements

Guo et al. have written an article suggesting a conceptual framework TeMPS that characterize the important aspects of pervasive games [22]. Based on this framework, we have developed questions for survey II that fits into the proposed framework.

The framework consist of the following elements:

- ▷ *Temporality*: addressing the temporal property about the game, i.e. the game is played in fixed time/round or not (open beginning and/or open ended)
- ▷ *Mobility*: addressing the spatial property whether the game could be played anywhere or fixed in one place
- ▷ *Perceptibility*: addressing how the game is mixed with the reality, e.g. does the game construct the appearance of the player proxy in game by sensing the player's real world appearance? Does the player need to physically move to move virtually in game?
- ▷ *Sociality*: addressing the player's relationship and social influence of the game.

Each of the elements or categories have their extended definition as seen in the article written by Guo et. al. [22], and the next sections describes our questions to the respondents of survey II.

10.2 Questions

The survey first give the respondent a few game concepts. They are firstly given a base concept, and then some questions rating that concept. Then, the concept is changed (added a pervasive element), and the users are asked to compare this to the base concept.

10.2.1 Survey and question layout

The following describes how the survey is presented to the respondents, including questions and alternatives.

Base concept

Picture a knowledge game where you are introduced to questions about several different subjects. When completing a series of questions, you will receive points based on how many questions you managed to answer correctly.

The goal of the game is to complete as many series of questions as possible. The game is played on a portable unit, for example a cell phone or similar. The score of each player are available as an online high score list (website).

Question 1:

From 1 to 5, rank how interesting it would be to play this game

(with “real life”, we mean that one meet up with others to play, for example like a paintball or go-card events i managed today)

- ▷ *as the text says?*
- ▷ *single player vs other players?*
- ▷ *team vs team?*
- ▷ *alone against other players in real life?*
- ▷ *team vs team in real life?*

Location aware

Picture another game. In this games flags are place around a map of your current area. When approaching a flag, you can answer a series of questions to capture the flag. The questions asked is about the local region of where the flag is placed. For example, one could get questions about places, persons, events that has got some connection to the region.

When completing the series of questions, one will capture the flag, and it will contribute to your overall score as long as you own the flag. The goal of the game is to capture as many flags as possible, achieving the highest possible score. Other players can capture your flags by completing the same questions as you did when you captured the flag.

Question 2:

From 1 to 5: compared to the base concept in question 1, rank how interesting it would be to play this game

(with “real life”, we mean that one meet up with others to play, for example like a paintball or go-card events i managed today)

- ▷ *as the text says?*
- ▷ *single player vs other players?*
- ▷ *team vs team?*
- ▷ *alone against other players in real life?*
- ▷ *team vs team in real life?*

Proximity

Picture a third game. It is similar to the last game, but players steal nodes from each other in another way. Every series of questions that a player completes will be attached to the player. When to players are within some range of each other (for example 100 meters), each of the players can initiate a duel.

The one taking the initiative is called an attacker, while the other player is the defender. The defender chooses the questions the attacker need to answer. If the attacker gets a higher score than the defender, the attacker wins the duel and one of the defenders flags now belong to the attacker.

Question 3:

From 1 to 5: compared to the base concept in question 1, rank how interesting it would be to play this game

(with “real life”, we mean that one meet up with others to play, for example like a paintball or go-card events i managed today)

- ▷ *as the text says?*
- ▷ *single player vs other players?*
- ▷ *team vs team?*
- ▷ *alone against other players in real life?*
- ▷ *team vs team in real life?*

Augmented reality

Same as the last concept, but instead of displaying the nodes and players on a game map, players will have to use the device built in video camera in order to see flags/players. The device will capture video and put virtual representations of flags and players (ex. a hat or an avatar) on top of the video stream. The user will then use this interface to locate flags, and when they come closer than 20 m of a flag, they may select the node, and start a series of questions to capture it.

Question 4:

From 1 to 5: compared to the base concept in question 1, rank how interesting it would be to play this game

(with “real life”, we mean that one meet up with others to play, for example like a paintball or go-card events i managed today)

- ▷ *as the text says?*
- ▷ *single player vs other players?*
- ▷ *team vs team?*
- ▷ *alone against other players in real life?*
- ▷ *team vs team in real life?*

Pervasive elements

This part of the survey presents you with a number of statements concerning different elements about games. For each statement you must rank how agreed upon you are.

Temporality (rank from 1-5: Totally disagree to Totally agree):

- ▷ Question 5: I prefer games with a fixed amount of time for a session. A session should have a definitive start and end, and quitting during the session would mean you do not gain points for the session.
- ▷ Question 6: I prefer games which are possible to start and end at any time I want, and I should be able to play for any amount of time before quitting.
- ▷ Question 7: I prefer games which can be played asynchronous (game is always running at a web site or server) and the game should be able to notify me about in game events (other users do something, prompting response from me) by sending messages to my mobile unit.

Mobility

- ▷ Question 8: The value of a game would increase if the game could be played anywhere (mobility is more important than for example graphics)
- ▷ Question 9: The value of game would increase if my geographical location is decisive for the game (for example that i have to be in a given location to affect different game elements)

Perceptibility

- ▷ Question 10: The value of a game would increase if the game could be controlled with visual commands (the game can use cameras to see movement in the real world - and act based on that)
- ▷ Question 11: The value of a game would increase if the game could be controlled with voice commands (I control the game via a microphone)
- ▷ Question 12: The value of a game would increase if the game could record my feelings and act based on them (for example that the game measures heart rhythm and knows when the player is scared, relax and so on)
- ▷ Question 13: The value of a game would increase if i could control the game by moving in the real word (game changes when player changes location)
- ▷ Question 14: The value of a game would increase if i could control the game by moving real world objects (for example by opening a door in real world would open a door in game)

Presentation

- ▷ Question 15: The value of a game would increase if it can show me feedback visually (for example on a monitor)
- ▷ Question 16: The value of a game would increase if it can give feedback by mixing computer graphics and video (a monitor with virtual objects mixed with video images)
- ▷ Question 17: The value of a game would increase if it can give feedback with the use of sounds (changes in music, sound effects, etc)
- ▷ Question 18: The value of a game would increase if it can give me feedback with the help of movement, shaking controllers, etc.
- ▷ Question 19: The value of a game would increase if it can move objects in the real world (if i open a door in the game, it would open a door in my house)

Social

- ▷ Question 20: The value of a game would increase if I can compete with others to reach my goals
- ▷ Question 21: The value of a game would increase if I can cooperate with others to reach my goals
- ▷ Question 22: The value of a game would increase if I can communicate with others playing the game
- ▷ Question 23: It is important for me to learn something from playing a game

Open ended questions

- ▷ Question 24: What do you mean are the most important challenges with game technology as mentioned above? (Location based games, games mixing real- and virtual reality, augmented reality, etc)
- ▷ Question 25: Do you have any comments to the concepts in this survey or this sort of game technology in general?
- ▷ Question 26: Do you have any comments to the questions or distribution of this survey?

10.3 Testing

For survey II, we did not test as extensively as for survey I.

Part IV

Results

User groups and demography

The choice of method for publishing and collecting the survey led us to a unique composition of user groups and demography in our survey. In this chapter we will look at the different groupings of participants we have identified, and on what (if any) differences there are between groups of the same type. The bias resulting from our sub-population will be discussed in the last section of this chapter.

11.1 Number of respondents

The total number of respondents for Survey I was 655. Although having 655 respondents, we added logic into the survey, enabling users to skip several questions not relevant for them. This is relevant for all the questions in the survey except the profiling questions (first few). Below is a table with respondent statistics for each question in the survey. The entries marked with an '-' were optional questions asking for text input, comments.

Table 11.1: Survey I respondent count for each question

	Q01	Q02	Q03	Q04	Q05	Q06	Q07	Q08	Q09
Respondents	655	655	655	655	655	655	655	655	655
	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18
Respondents	655	655	501	501	501	501	501	501	-
	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27
Respondents	501	453	453	433	433	433	433	433	433
	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	
Respondents	-	433	151	151	655	655	655	-	

11.2 Demography

The demography of our participants is important to better understand the answers and bias of the survey. The demography of our participants will be described compared to the total demographics of Norway. We will also look at the demographics of each of our sources.

11.2.1 Demography by source

Since we collected the data from multiple sources, a look at the differences in the demography of the sources might be interesting. For information about the sources themselves, see Section 9.4.

Overall, the major age group in our survey was people in their twenties, with people in thirties and teens coming second and third. The survey is extremely male dominated. Social status is fairly balanced, when compared to the SSB data, and taken in account for the age skew.

According to data from SSB (Statistisk Sentralbyrå/Statistics Norway) for 1. January 2010[1] all our age groups except the 60+ should be fairly equal, about 12-14%. This means the 20-29 age group in our data is very overrepresented, while the 40-49 age group and especially the 60+ age group is very underrepresented. However, this is to be expected, since there are more people of the overrepresented age groups who play games or use mobile applications than in the underrepresented age groups. In itself this is not a problem, since the target audience of mobile applications/games is the same as the demographic we have collected data from. Not surprisingly, our gender composition is very biased compared to the SSB data. When it comes to social status, SSB only has data for married people vs unmarried and formerly married people. It shows a roughly equal share of people who are single and people who are either married, or have been married. However, the amount of married people greatly correlates to greater age, which may explain why we have so little married people, when compared to the age groups we have, the data seems fairly consistent with the SSB data.

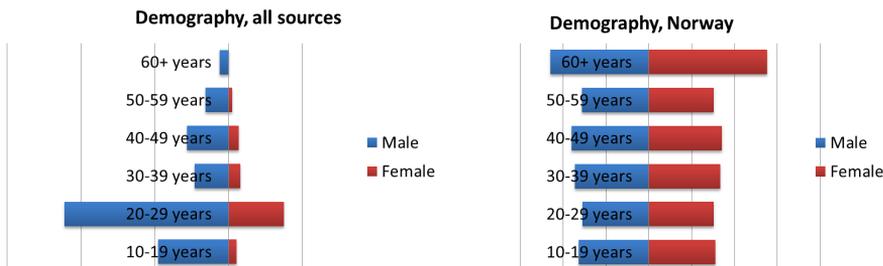


Figure 11.1: Demographics of the survey participants

- ▷ Notice the age group 20-29 is extremely overrepresented, and especially people over 60 and females are severely underrepresented.

Normally, it would be possible to normalize the data using these demographic numbers by weighting the answers of the people who are underrepresented more than other answers. (if any demographic group, for example females between 50-59 are underrepresented by a factor of 1 to 5, we could count their answers five times. In this test, however, we do not have enough answers from these minorities for them to be representative. A broader scope is needed when analyzing the minorities. Something we can do is to look at the answers of different subgroups like “people over 50” and “females” and try to see if their answers differ in any significant ways from the mean.

11.2.1.1 Gamer.no

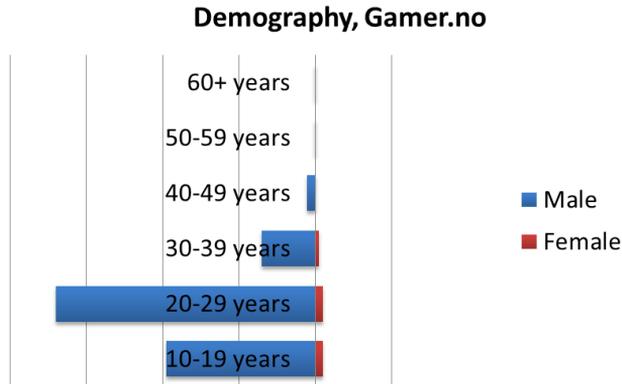


Figure 11.2: Demographics of the survey participants from Gamer.no

The subjects from Gamer.no is slightly younger than the mean, with 32.02% in the 10-19 age group, 54.69% age group and only 13.28% above that. Gamer.no is extremely male dominated, with 96.09% males. Compared to the overall group, there are more single respondents and less married respondents.

11.2.1.2 Diskusjon.no

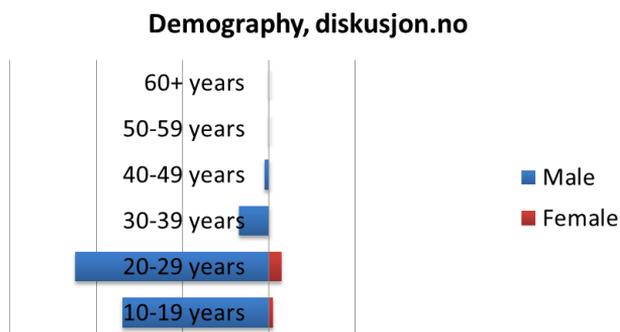


Figure 11.3: Demographics of the survey participants from diskusjon.no

Diskusjon.no is similar to Gamer.no, but slightly younger, with 38,46% in the lowest age group, 52,75% in the 20-29 age group, and only 8,79% 30 and above. As with Gamer.no, Diskusjon.no is extremely male dominated, with 95.6% males. Also similar to Gamer.no, there are more single respondents and less married respondents compared to the overall group, but slightly more married people.

11.2.1.3 NetCom

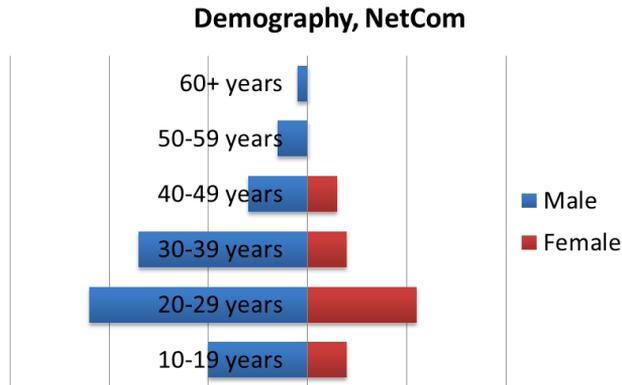


Figure 11.4: Demographics of the survey participants from NetCom

NetCom is a fairly balanced group, with 17,28% in the lowest age group, 40,74% in the 20-29 age group, 25,93% in the 30-39 age group, and 14,81% 40 and above. Gender wise, NetCom is more balanced than all but NTNU, with 72.84% Males. When it comes to social status, NetCom is fairly equal to the overall score.

11.2.1.4 Apps AS

Apps AS is the most balanced group when it comes to age, with 9.43% in the first age group. 10,38% in the second, 31,6% in the third, 26,42% in the fourth, 16,98% in the fifth, and 5.19% over 60. This source is also male dominated, with 85.38% males. Compared to the overall social status score, Apps AS has very much fewer singles and people in relationships, and very much more married people.

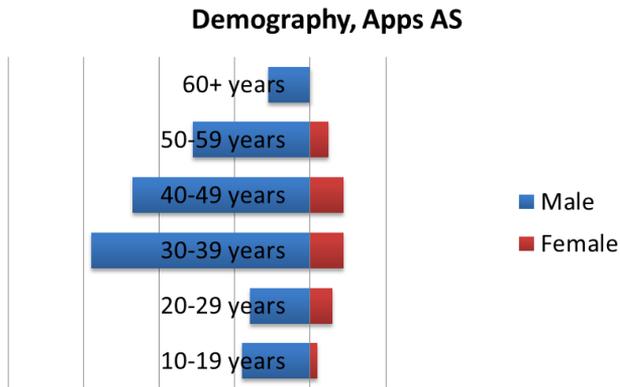


Figure 11.5: Demographics of the survey participants from the Apps AS mailing list

11.2.1.5 NTNU

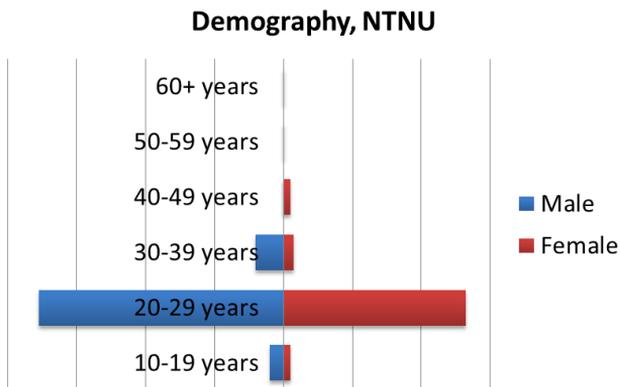


Figure 11.6: Demographics of the survey participants from NTNU

NTNU is the least balanced group when it comes to age, with 86,71% belonging

to the 20-29 age group. However, the group is the most balanced when it comes to gender, with 58.04% males, and 41.96% females. NTNU is close to the overall social status score, but has slightly less people in a relationship, and allot less married people.

11.3 Subgroups

We will here look at the different subgroups in our population, and try to see what differences there are between them. The main subgroups of interest for us is *Mobile gamers* (people who play games on mobile devices), *PC/Console gamers* (people who play games on stationary devices) and *Non-gamers* (people who do not play games on either type of device). The *Non-gamer* group only has 64 members, whereas the other groups both have 433 respondents. The data for the *Non-gamers* might therefore not be as reliable. Also, as previously mentioned, most of these *Non-gamers* still have an interest for technology, mobile applications and/or games in general.

11.3.1 Activities

From our survey, the most popular activities seem to be TV/film and computer games, with respectively 76.49% and 66.87% of the survey participants saying they undertake these activities. Other popular activities include Books, Music and sports. An bias toward computer games and TV/film was expected, due to our deployment method and age/sex bias. Some activities mentioned by the people who checked “other” option (19.39% of the participants checked “other”) in the survey were:

Table 11.2: Other activities from survey I

Fishing	Voluntary work	Facebook	Animals (Horses, dogs)
Scrap booking	Technology	History	Photography / Video
Social/family	Parties	Being a parent	Food
Blogging	Traveling	Programming	Diving
Racing	Cars/Motorcycles	Knitting	Airplanes
HiFi (Audio equipment)	Choir	Interior design	Painting
Golf	3d animation	Drugs	Training/Fitness
Theater	Finance	Church	Amateur radio/electronics
Math puzzles	Surfing the web	Poker	Dancing

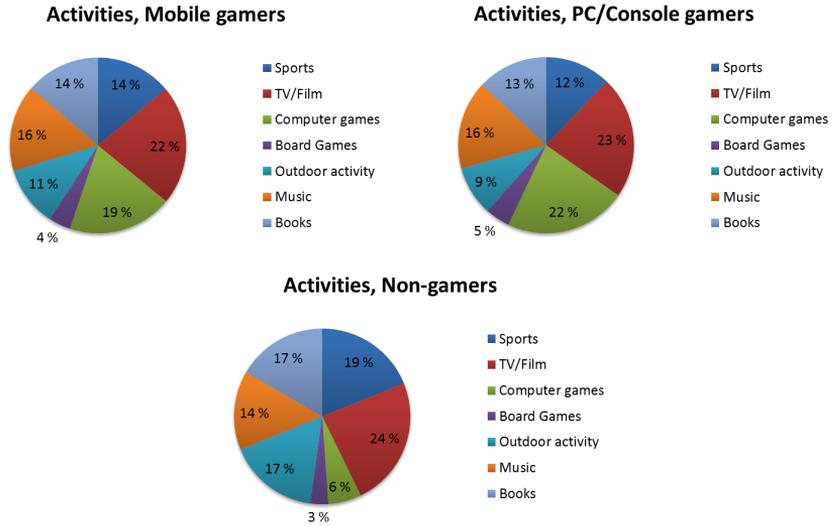


Figure 11.7: Activities by user group

- ▷ PC/ Console gamers: People who answered yes to Q10, “Do you play games on computers/consoles”
- ▷ Mobile gamers: People who answered yes to Q11, “Do you play games on mobile devices”
- ▷ Non-gamers: People who answered no to Q10 and Q11

Non-gamers tend to participate more in outdoor activities and sports than gamers, but spend less time on music, board games and TV/film. Strangely, some non-gamers did say that they do play computer games. This could be due to people who sometimes play games, but felt they did not play enough games to answer yes to the other questions. It should be noted that due to the way we published our survey, our participants are people who have an interest in games, mobile applications and/or information technology. Among gamers, it seems that stationary gamers listen slightly more to music, and watch more TV/films.

11.3.2 Age

Here we will look at the age composition of the different subgroups.

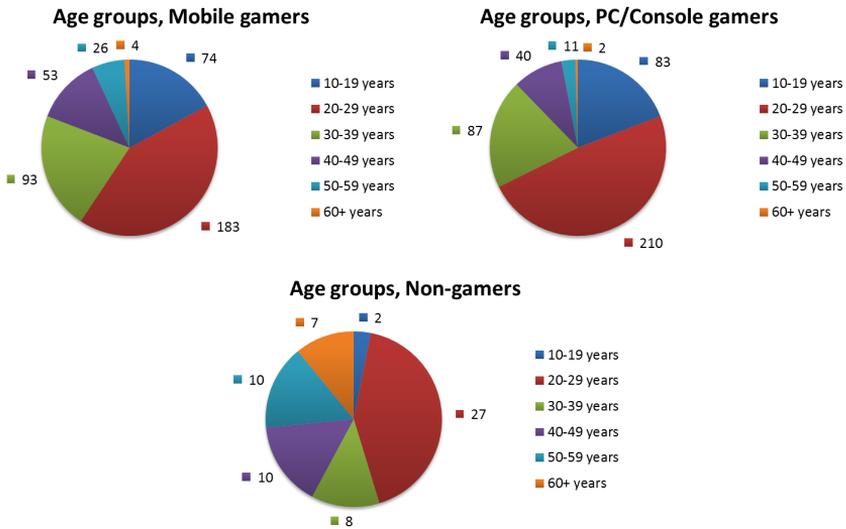


Figure 11.8: Age composition by user group (in number of respondents)

The data shows a strong correlation between Non-gamers versus stationary players and age, as seen in the figure above . There is also a light correlation between mobile gaming and age, but not as large as the correlation of stationary gamers.

11.3.3 Gender

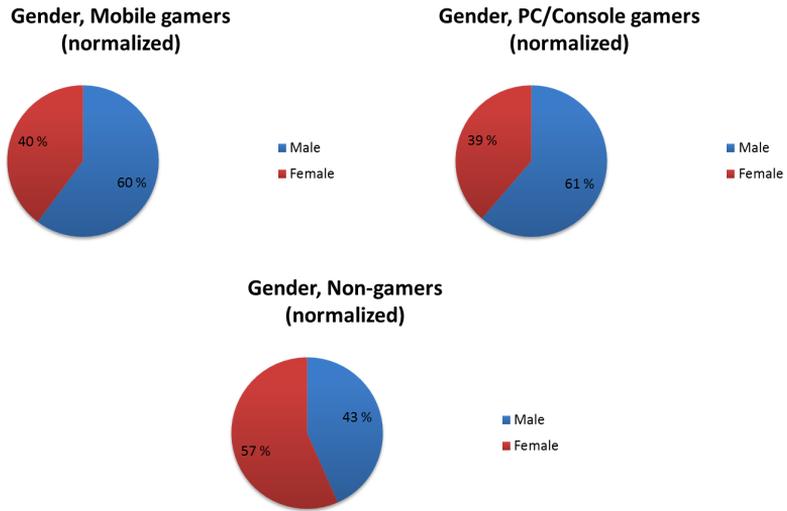


Figure 11.9: Gender by subgroup, normalized for correct gender distribution

Because of the great difference in number between male and female participants in this survey, we normalized these charts (in Figure 11.9) to remove bias. We did this by weighting the female participants to coincide with the general population of Norway. Each female result is weighted with a factor of 2,866071429 (amount of males in the study divided by the amount of females multiplied with the distribution in the general population taken from SSB) whereas males are weighted with a factor of 1. Some bias may still be included, due to our limited selection of females. The main reason we did not do this for all segments and use normalized values for all data extraction is the great uncertainty and possible bias which comes from greatly over-representing very small groups of our survey. For example, the 60+ part of our study is only 12 people, but should represent roughly 20% of the population. Each of these would have to be weighed with a factor of ~6, which would make any discrepancies in this small group (12) from the total population to become 6 times larger.

From these normalized charts, we can see that fewer males are non-gamers, but the stationary vs mobile gamers are fairly equal for the sexes.

11.3.4 Income

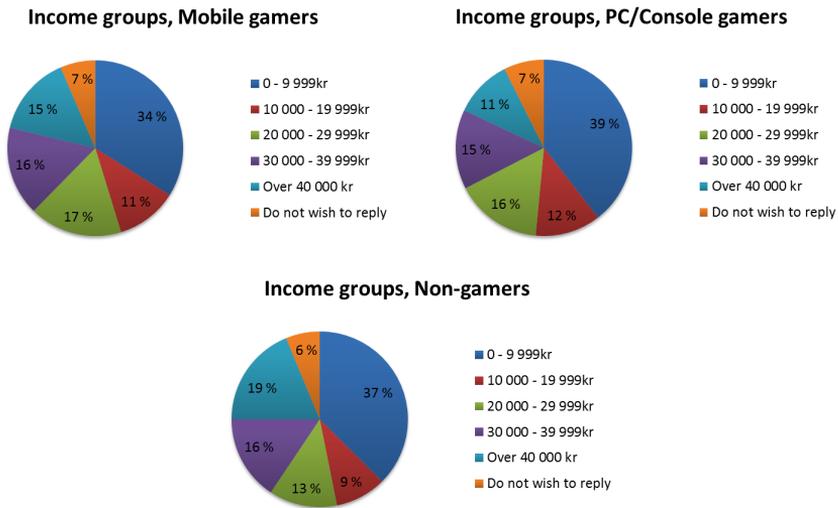


Figure 11.10: Income by subgroup

Income wise, we see that the amount of people from the highest income group is higher in the *Non-gamer* population than in the other two groups. The *PC/Console* gamers generally have a lower income than the other groups, while the *Mobile gamers* are the most average.

It should be pointed out that there exists a strong correlation between age and income, and we have already seen a correlation between non-gamers and age. The general high percentage of our survey participants in the lower group (0-9 999kr) may be because of the high amount of students who undertook the survey (53.8% of the participants were students), many of which have no other means of income than student loans.

11.3.5 Education

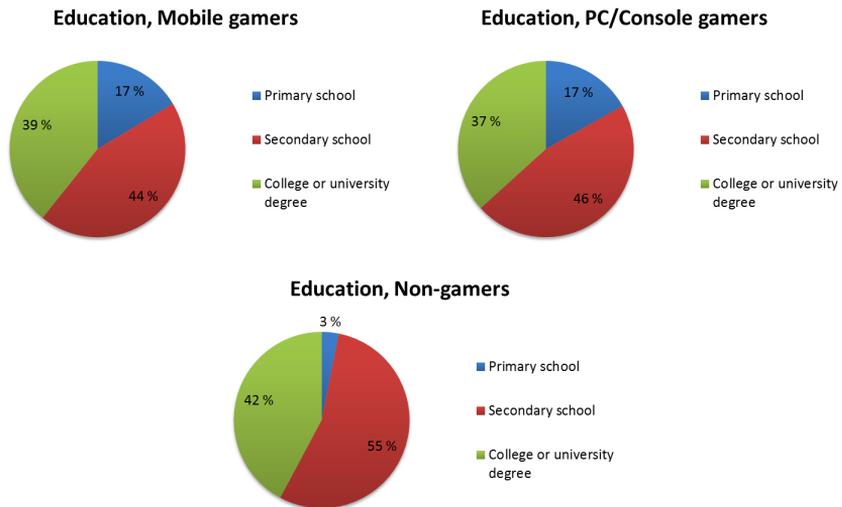


Figure 11.11: Education by user group

When it comes to education, we see that the *Non-gamers* are the best educated, while *Mobile gamers* tend to have slightly higher education than *PC/Console gamers*. Again, as there is a strong correlation between greater age and *Non-gamers*. In addition, we previously saw that females were more likely to be *Non-gamers*. Since a large portion of the females in this study came from the NTNU source, they alone will introduce a large skew. Therefore we also looked at if the study participants were still under education, as we can see from the figure beneath. From this we can see that there is 5-10% more *PC/Console gamers* under education than there are people in the other groups under education. It would therefore seem that the difference in education between *PC/Console gamers* and *Mobile gamers* can be dismissed. There is however a too large difference between *Non-gamers* and the other groups to be explained by this alone. Still, because we have so few *Non-gamers* in our study the differences may be lesser than what we see from our data. At any rate, there

seems to be a correlation for *Non-gamers* to be better educated than people who play games on any type of device.

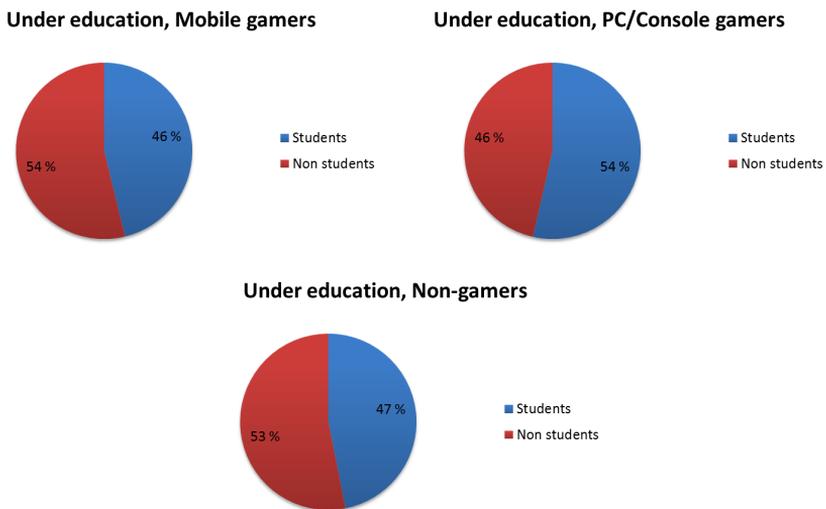


Figure 11.12: Students by user group

11.3.6 Social status

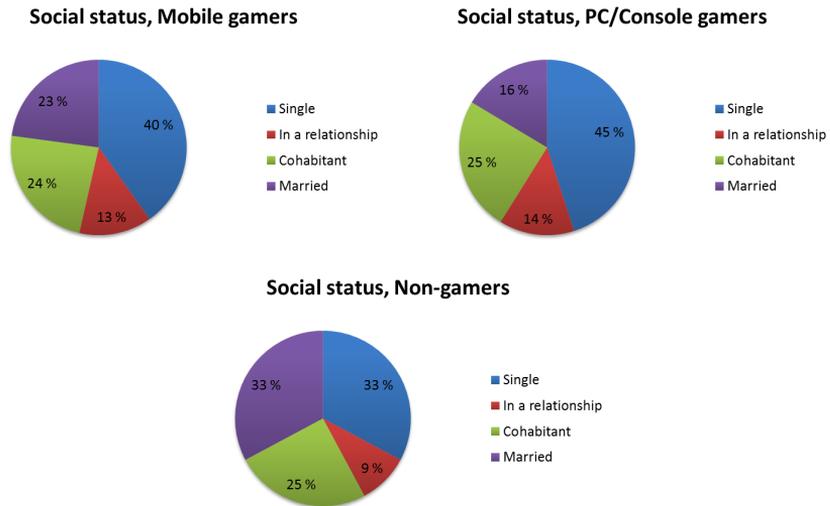


Figure 11.13: Social status by subgroups

From the data we can see that Non-gamers are more likely to be married than gamers, and mobile gamers are slightly more likely to be married than stationary gamers. Likewise, non-gamers are less likely to be single or in a relationship where they are not married or living with their partner. This could be explained by the age difference between non-gamers and gamers.

11.4 Bias

There are three main sources of bias for these results.

First, we used prizes as a means of attracting people. We had a total of 9 prizes for our two surveys, 8 gift cards for the first and an iPod Touch for the second.

It is obvious that this might introduce some bias to our results. Respondents might answer inaccurately in order to complete the survey as fast as possible, or similar kinds of behavior. We have not found any suitable research into how much bias this might generate.

In section 11.4, our respondent demography is presented. Overall, the major age group in our survey were people in their twenties, with people in the thirties and teens coming second and third. The survey is extremely male dominated. Social status is fairly balanced.

Information on our sources can be found in section 11.2, we have two Internet game forums, one iPhone blog and facebook fan page, one e-mail list from a iPod app developer company and a student portal at a university. Based on the sources, we have reason to believe that many of our respondents are above average interested in both games and portable technology.

All these possible sources of bias are important to remember when reading the results. It seems that parameters like age, income, social status and gender sometimes lose their importance or influence due to other parameters introduced by this bias. For example, even though we have some respondents that are over 40 years old, it might be that all the respondents are extremely interested in games. This interest in games are more likely to be influencing the respondents answers, rather than his or hers age. Another factor is that the older age groups have very few responses. This will introduce bias as extreme opinions will have more impact on the results if there are few respondents.

Usage Patterns

Asking users about their usage patterns on portable devices shows us some interesting data compared to the more traditional stationary gaming situation. This chapter elaborates on the results from the first survey.

We see both the expected and unexpected. Portable game sessions are shorter, and often the result of some other main activity. Survey I was deployed to several forums and blogs online, provided by one of the largest cellular phone companies and one of the largest iPhone application developer companies in Norway.

The results from survey I are presented in this chapter. It is important to read about our demography and sources in the previous chapter to get a proper understanding of the background for the results. For example, we have a respondent population crowded by young males. Considering the respondent demography, the results are most likely not valid for a generic population of both gamers and non-gamers.

12.1 Important: tables and statistics

Where relevant, we supply a table with some statistics concerning responses. The rows in these tables are “median”, “mean”, “standard deviation” and “highest frequency”. For mean and median, the actual value given by us is the number for the answered option. For example: if “0 - 5”, “6 - 10” and “11 - 15” are the three alternatives, “0 - 5” would have the value 1, “6 - 10” value 2 and “11 - 15” value 3.

An explanation of the data follows:

Median¹. A median is described as the numeric value separating the higher half of a sample, a population, or a probability distribution, from the lower half. It represents an average in observations rather than actual values, giving us a better mean result if we have extreme observations.

Example: If we have 5 responses, 3, 9, 15, 17 and 440. Finding the median means finding the observation in the middle, in this case which is 15. 15 would then be our median value, and describe the result set in a better way than a mean value (see mean example below).

Mean². In mathematics and statistics, the arithmetic mean (or simply the mean) of a list of numbers is the sum of all of the list divided by the number of items in the list. This gives us the average value answered to a question.

Example: If we have 5 responses, 3, 9, 15, 17 and 440. You would add the responses and divide them by five (five responses). The mean value (average) would be 96,8.

Standard deviation (std. dev.)³. In probability theory and statistics, the standard deviation of a statistical population, a data set, or a probability distribution is the square root of its variance.

Highest frequency. The answer which is preferred by the highest number of respondents.

¹[HTTP://en.wikipedia.org/wiki/Median](http://en.wikipedia.org/wiki/Median)

²<http://en.wikipedia.org/wiki/Mean>

³http://en.wikipedia.org/wiki/Standard_deviation

12.2 Game session frequency

The participants were asked how many session they play on weekdays and weekends on both mobile and stationary devices (Q12, Q13, Q22 and Q23). Figure 12.1 shows the response for mobile devices. As one can see from the figure, the number of sessions on weekdays are varying, but with a concentration around 1-6 sessions. Alternative 2 got 43% and alternative 3 got 15% of the answers. This is also the case for weekends, but with the frequency somewhat lower in total (lesser answers for the high frequency alternatives, increase of 7% for the none alternative).

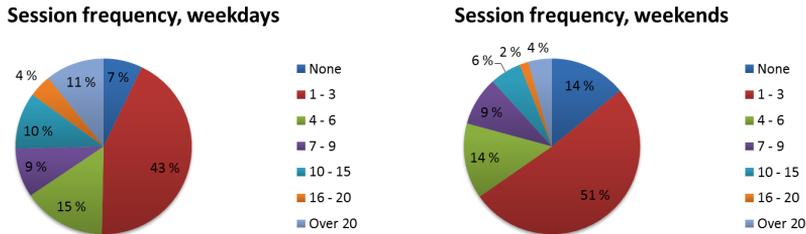


Figure 12.1: Game session frequency for portable devices

From table 12.1, we find that the median for both weekend and weekdays are alternative 2 (1-3 sessions), with the mean somewhat different. The difference in mean shows that the number of sessions are somewhat higher in the weekdays (3,28) compared to the weekends (2,63). This effect can also be seen in the figures.

Table 12.1: Game session frequency statistics for portable devices

	Weekdays	Weekends
Median	2	2
Mean	3,28	2,63
Std. dev.	1,51	1,11
Highest freq	2	2

Comparing the results for portable devices with the results for stationary devices like computers and game consoles is interesting to see the differences in usage patterns for the two “platforms”. The numbers in figure 12.2 show that the alternatives with the high number of sessions have fewer responses, but that the overall number of sessions are higher.

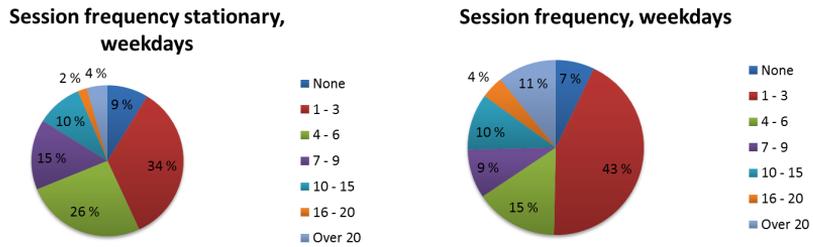


Figure 12.2: Game session frequency on weekdays

Comparing table 12.2 to table 12.1, it is difficult to draw any conclusions or find any trends comparing portable and stationary devices. The number of sessions are higher for portable devices on weekdays and lower on weekends, compared to stationary devices.

Table 12.2: Game session frequency statistics for stationary devices

	Weekdays	Weekends
Median	3	2
Mean	3,06	2,76
Std. dev.	1,12	0,92
Highest freq	2	2

12.2.1 Income

Looking at income (figure 12.3 and 12.4), it does not seem to be any significant differences between the groups. There are some differences in the chart, although not enough to see any clear differences. The two lowest income groups seem to have a somewhat lower game frequency, both in weekdays and week-ends.

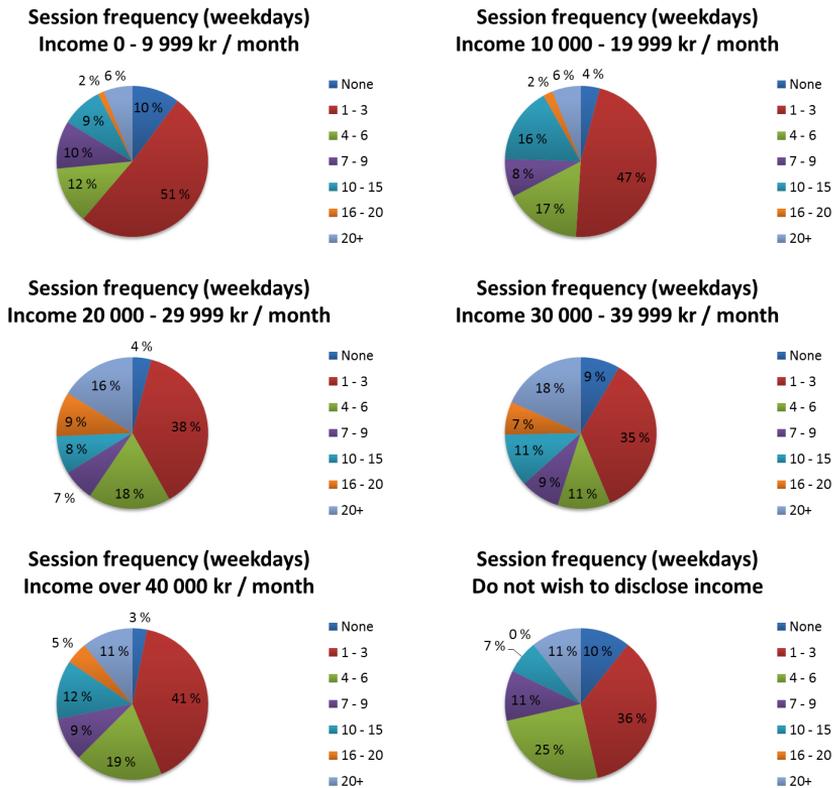


Figure 12.3: Session frequency on portable devices by income

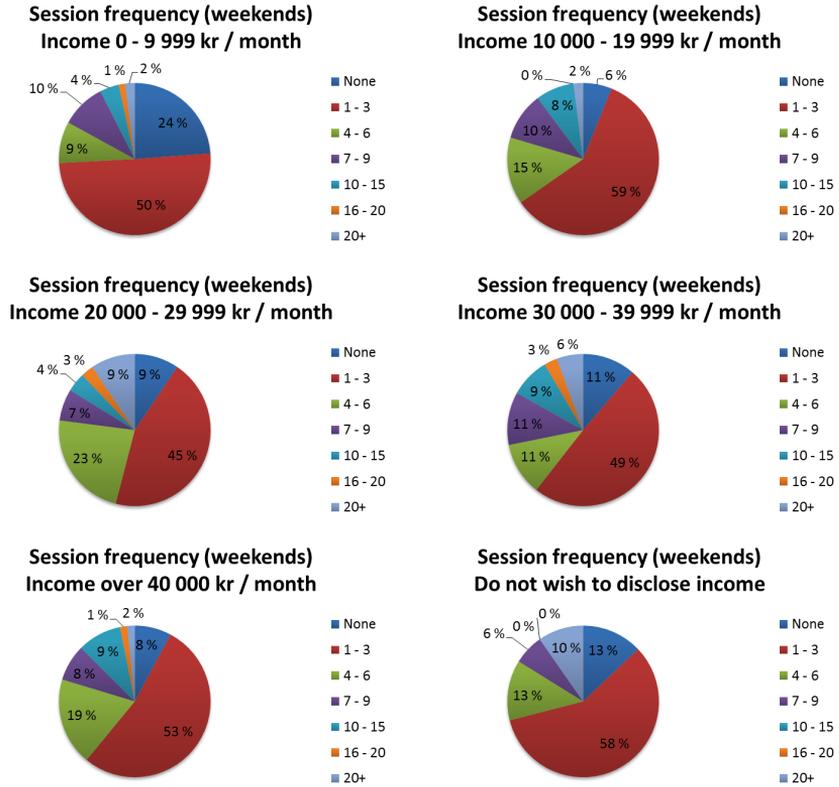


Figure 12.4: Session frequency on portable devices by income

12.2.2 Age

For age (figure 12.5 and 12.6), one can see that the group 60+ stands out. It is important to note that data grouped by age is less representative for older age groups, as they have fewer people in them. Especially the “60+” age group is very clustered, as there are only four people in that group. The younger age groups have very similar responses. For weekdays, the group 40-49 seem to have a somewhat higher game session frequency compared to the other groups,

the graphs are shifted to the right of the figure. The group 10 - 19 years also seem to have a larger concentration around 1 - 3 sessions than the other age groups.

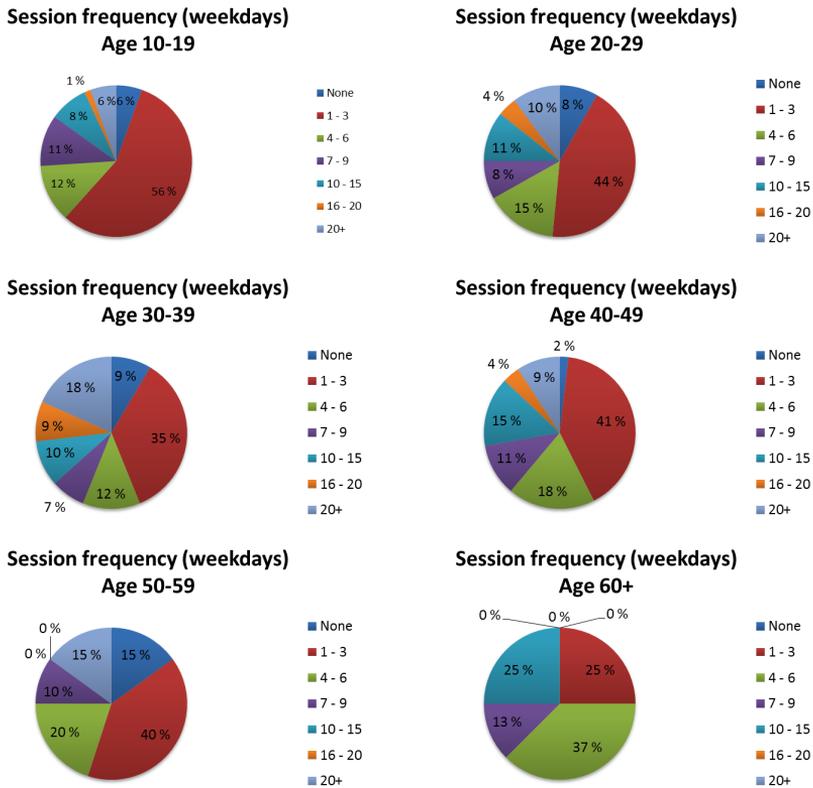


Figure 12.5: Session frequency on mobile devices by age

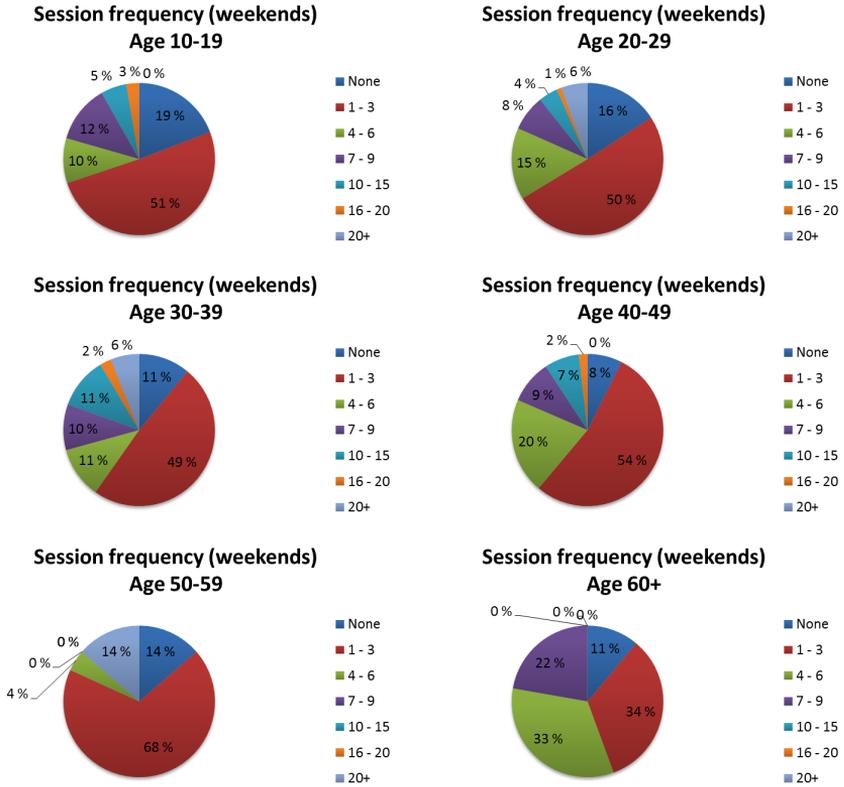


Figure 12.6: Session frequency on mobile devices by age

12.2.3 Gender

Both the male and female groups seem to have the same game session frequency pattern. There is a difference on weekdays for the 1 - 3 alternative, the female group having a higher number of responses there, and lower on most of the other alternatives.

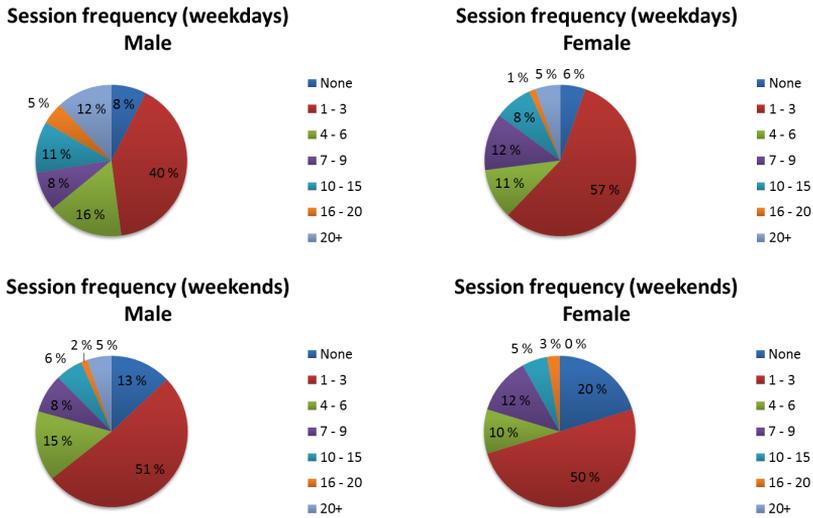


Figure 12.7: Session frequency on mobile devices by gender

12.2.4 Social status

Social status does not seem to have much effect on game session frequency. Married respondents seem to have a somewhat higher frequency on weekdays than the others.

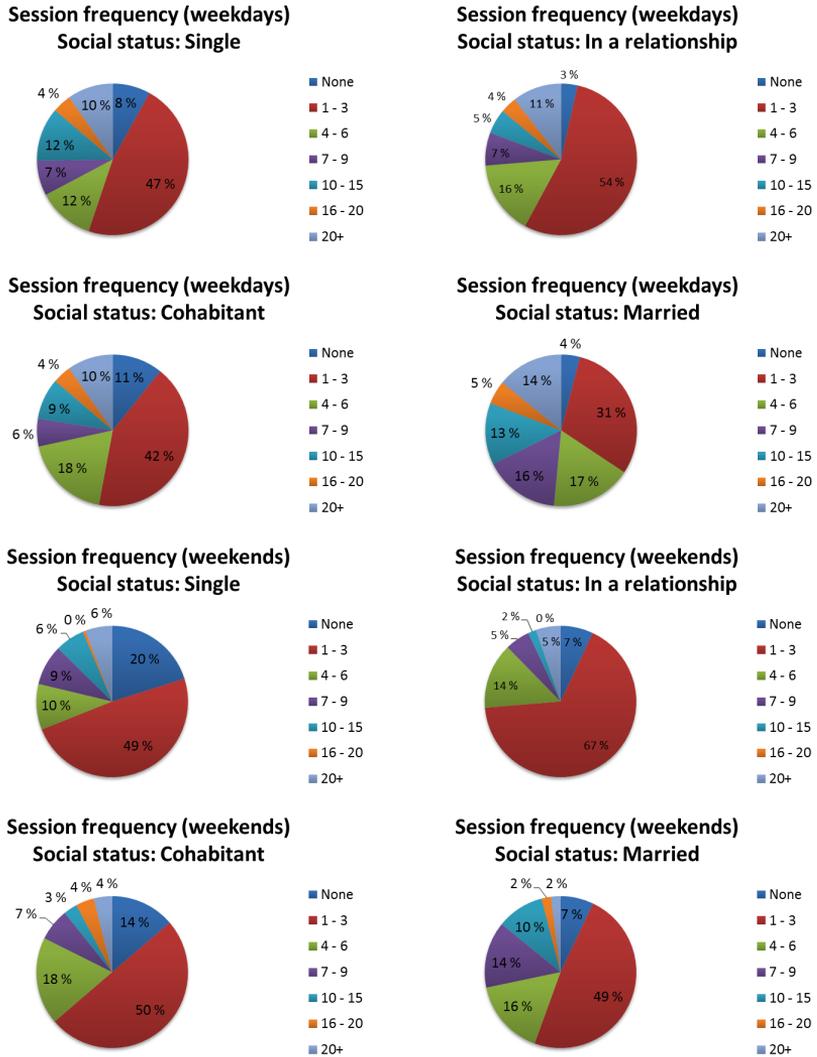


Figure 12.8: Session frequency on portable devices by social status

12.3 Game session length

The game session length for portable devices are not very different in weekdays and weekends. Both the table and the graph shows fairly consistent that the session length are similar. The mean answer is alternative two, with 6-15 minutes. The average being 2,2 and the next most used alternative being 0-5 minutes, one can say that the most common session length for portable devices is between 0 and 15 minutes. Very few people play more than 1 hour.

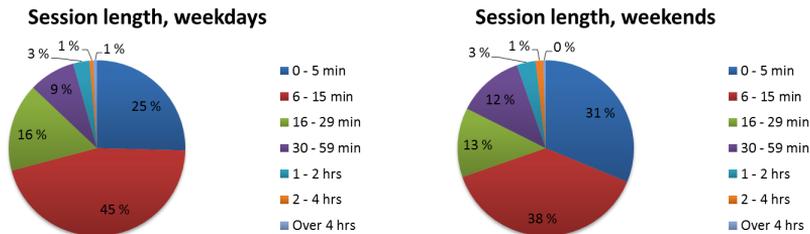


Figure 12.9: Session length for portable devices

Table 12.3: Session length statistics for portable devices

	Weekdays	Weekends
Median	2	2
Mean	2,23	2,24
Std. dev.	0,83	0,96
Highest freq	2	2

Compared to consoles and computers, the game session length is not surprisingly much shorter for portable devices. While the game session length for portable devices are usually between 0 and 15 minutes, the most common session length for stationary devices are between 30 minutes and 2 hours.

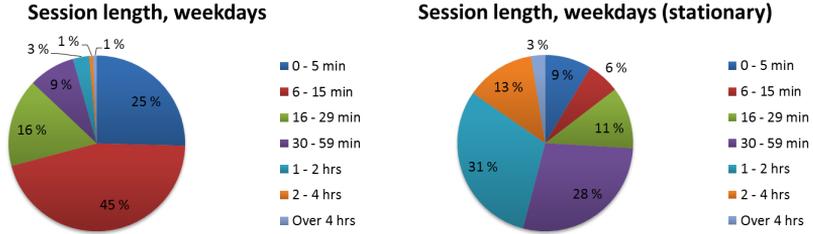


Figure 12.10: Session length on weekdays

From table 12.4, we can see that game sessions for stationary devices are even longer in weekends, with a mean and median close to alternative 5, 1 - 2 hours. While the game session length for portable devices does not change much between weekends and weekdays, this is different for stationary devices, as seen in the table data.

Table 12.4: Session length statistics for stationary devices

	Weekdays	Weekends
Median	4	5
Mean	4,14	4,72
Std. dev.	1,14	1,20
Highest freq	5	5

12.3.1 Income

For the different income groups, the results are very much the same as for game session frequency, however the two lowest income groups does not stand out as much in session length as in frequency. There are some differences for the “Do not wish to reply” group, with them seemingly having a longer game session duration on both weekends and weekdays.

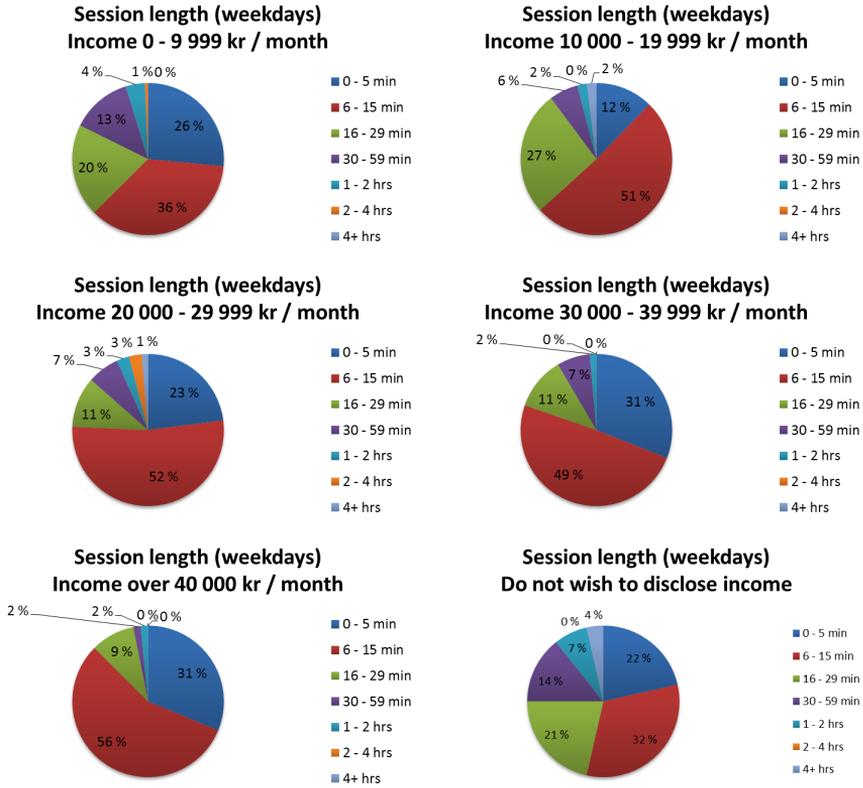


Figure 12.11: Session length for weekdays, mobile devices by income

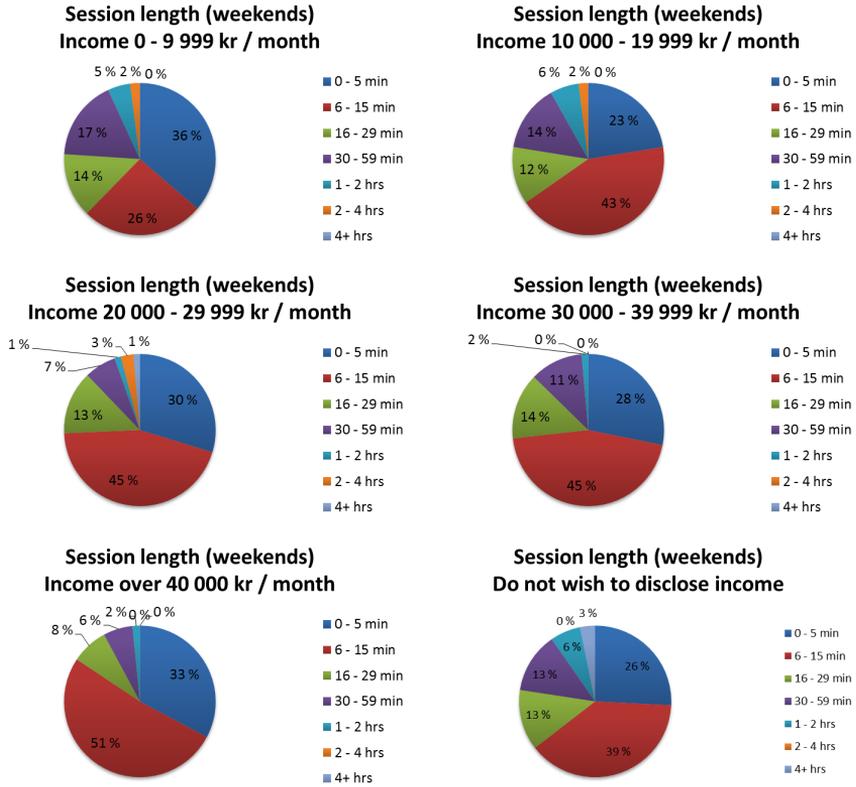


Figure 12.12: Session length for weekends, mobile devices by income

12.3.2 Age

In figure 12.13 and 12.14, the different age groups graph does not show any significant difference, except from the older age groups, in which have too few responses to draw any conclusions. There is a small trend in the graph showing that people between 10 and 19 seem to have a somewhat longer session duration.

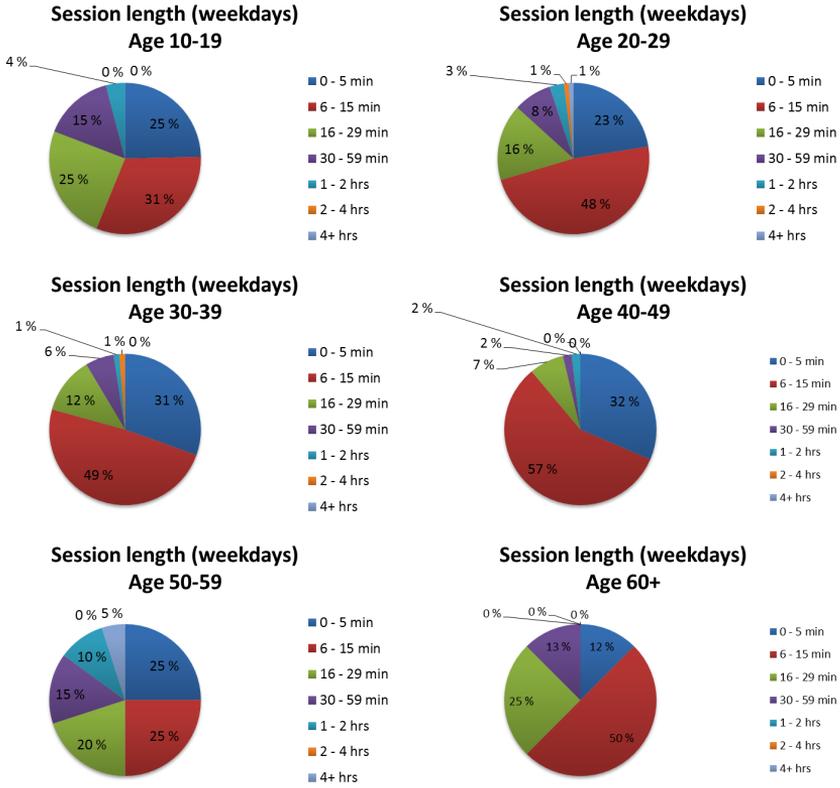


Figure 12.13: Session length for mobile devices (weekdays) by age

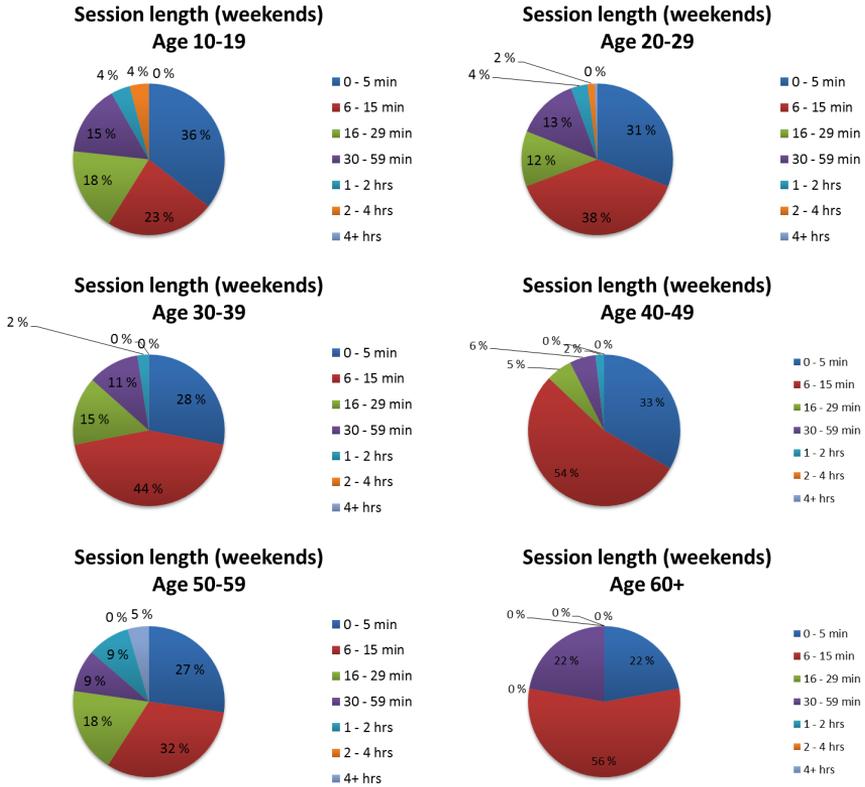


Figure 12.14: Session length for mobile devices (weekends) by age

12.3.3 Gender

There are some differences for game session length when it comes to gender. For weekdays, females seem to have a longer duration for session length in general than the male population. One should however consider a relatively low number of responses for females in this category. The same effect is also present on weekends.

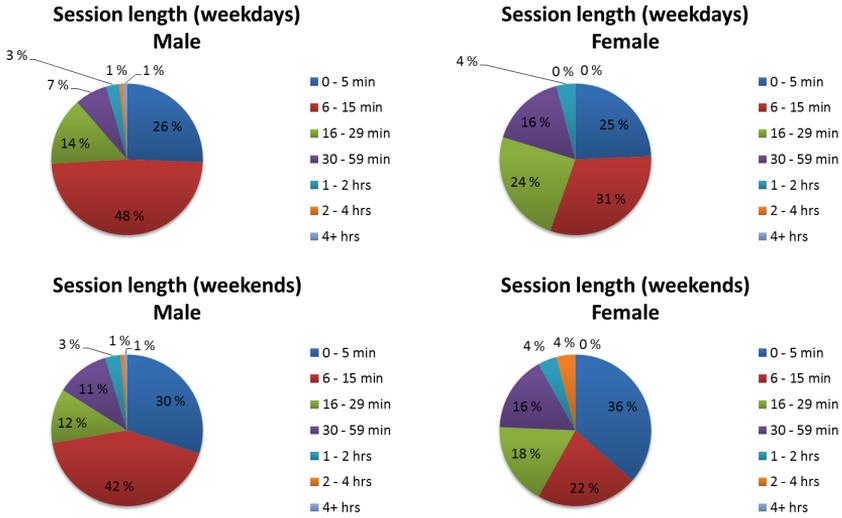


Figure 12.15: Session length for mobile devices (weekdays, weekends) by gender

12.3.4 Social status

As for frequency, married respondents have somewhat different replies than the others groups when it comes to game session duration. Especially the alternative 6-15 minutes stands out. This means that the married respondents might have a shorter average game session length.

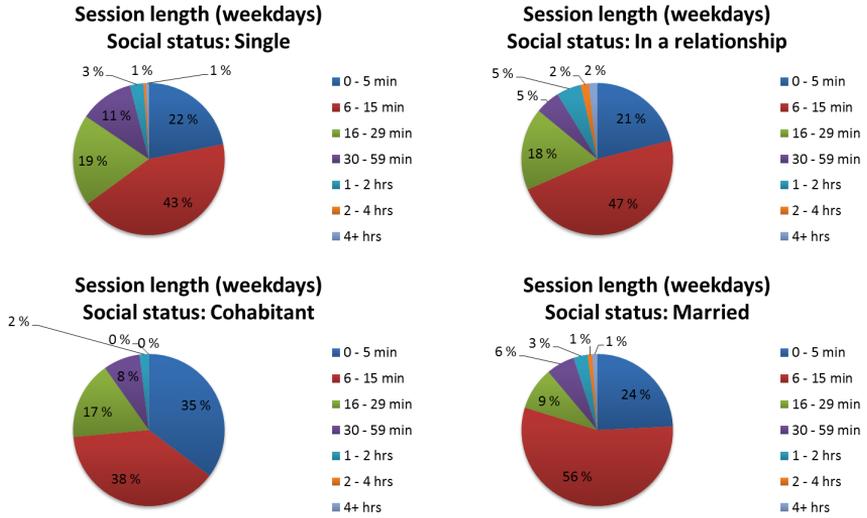


Figure 12.16: Session length for mobile devices (weekdays) by social status

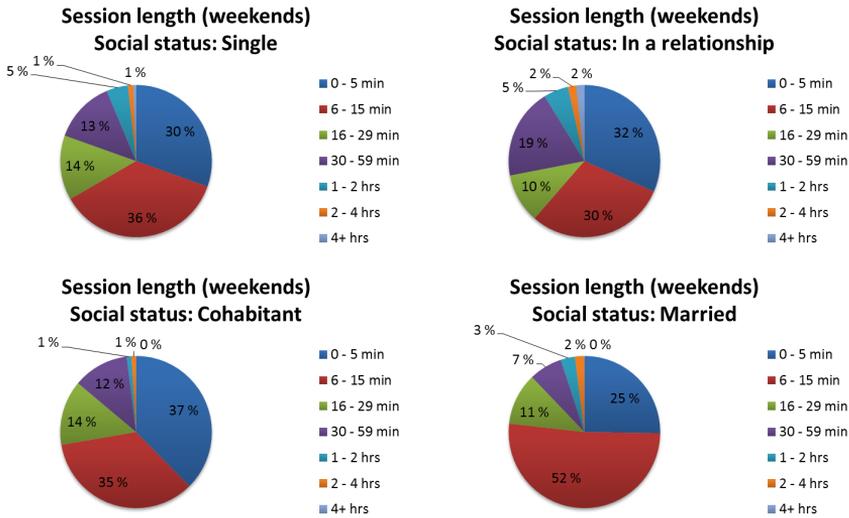


Figure 12.17: Session length for mobile devices (weekends) by social status

12.4 Multiplayer

From our prestudy we know that a lot of games on portable devices like for example the iPhone have support for multiplayer. We asked the users how often they play games with others both on portable devices and stationary devices. For portable devices the results shows us that these features are not often used. Looking at the graph, 62% say they never play games on portable devices with other people.

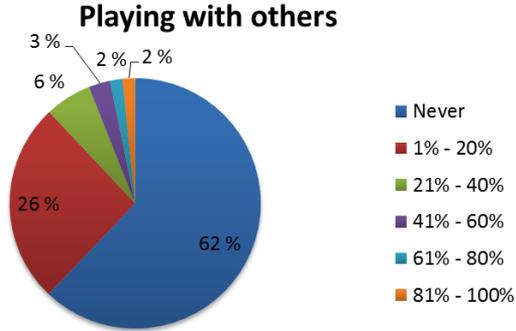


Figure 12.18: Playing with others - portable devices

The mean and median values from table 12.5 confirms the graph, telling us that most gamers never or rarely use multiplayer features on portable devices.

Table 12.5: Playing with others - portable devices

Median	1
Mean	1,60
Std. dev.	0,75
Highest freq	1

The participants were also asked about whether they play on the same location or device when playing with others. The results in figure 12.19 shows a tendency towards players either always play with the same device and location, or rarely does so. The results are, as one can see, centered around the never and always (81%-100%) alternatives. Not many players are between those two.

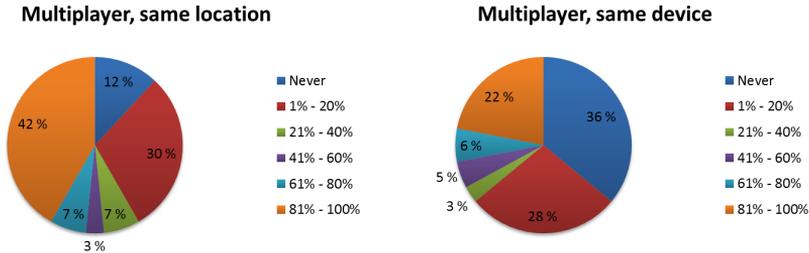


Figure 12.19: Portable devices - multiplayer

Comparing the results for portable and stationary devices (figure 12.20 and table 12.6 below), one can see that multiplayer features are more widely used in stationary devices. There may be several reasons for this, in which we will discuss in the discussions chapter. On stationary devices, the median and mean answers are around alternative three (41% - 60%), and the graph tells us that most people use multiplayer functionality. Only 10% say they never use this kind of functionality.

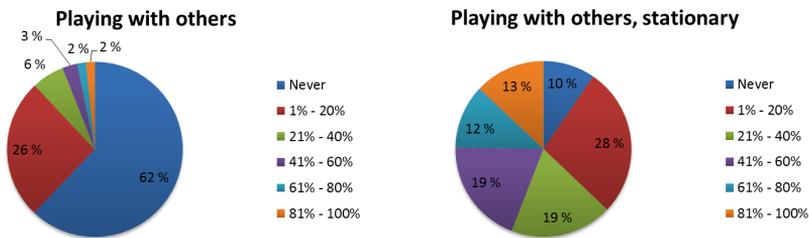


Figure 12.20: Comparing playing with others for stationary and portable devices

Table 12.6: Comparing playing with others for stationary and portable devices

	Portable	Stationary
Median	1	3
Mean	1,60	3,35
Std. dev.	0,75	1,32
Highest freq	1	3

12.4.1 Income

Looking at multiplayer, sorted for income, we can see that there is a tendency for people with larger income to play less with others. There is a strange tendency in the third income group, where the highest income groups are virtually nonexistent. This does not fit with the other groups however, and might be due to bias for that age group.



Figure 12.21: Multiplayer by income

12.4.2 Age

Figure 12.22 shows the age distribution for multiplayer, asking if the respondents are playing with others.

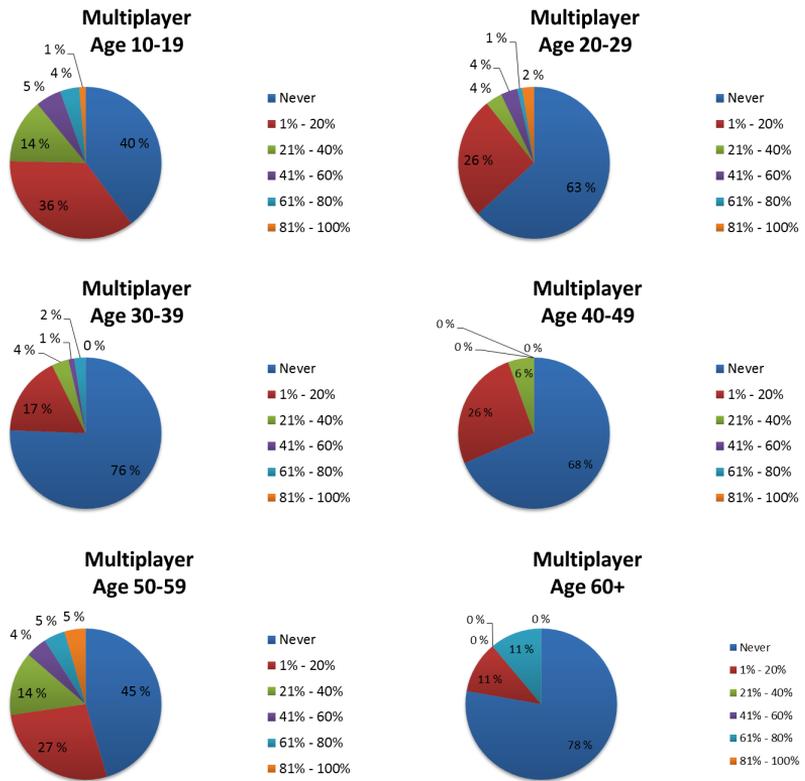


Figure 12.22: Multiplayer by age

12.4.3 Gender

Sorted by gender, there is a difference in responses showing that there are more females using multiplayer features on portable devices than males.

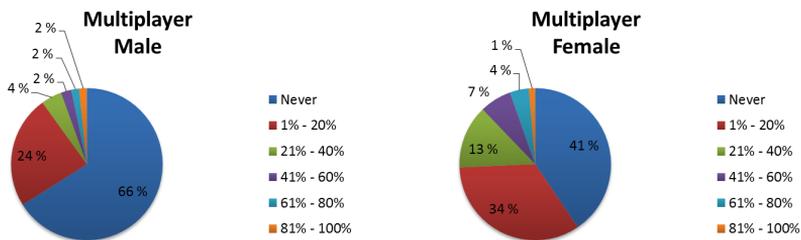


Figure 12.23: Multiplayer by gender

12.4.4 Social status

Social status does not seem to be an important factor here. There are some variations, but it does not seem to be a consistent pattern in the results.

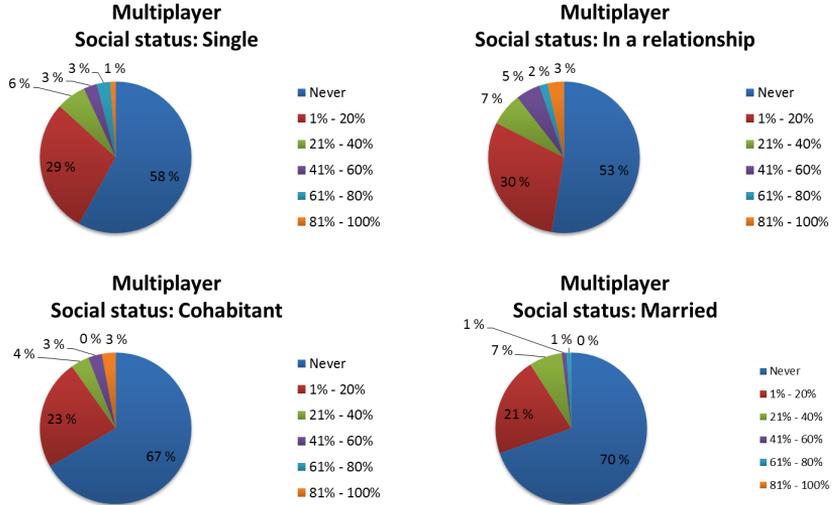


Figure 12.24: Multiplayer by social status

12.5 Motivation for playing

In order to investigate the players motivation for playing games on portable devices, we asked the users to rank a number of possible reasons based on how relevant they are (see table 12.7 below). Among these given alternatives, the replies suggest that the most important reasons for playing are related to relaxation, time consuming and entertainment, with time consume being the most important. Social, competitive and addiction reasons for playing does not seem to be important. This is supported by the mean and median values for the alternatives.

Table 12.7: Motivation for playing on portable devices

Reason	Small		Average		Very	Mean	Median
Relax	17%	12%	29%	21%	21%	3,1	3
Social	68%	21%	7%	2%	2%	1,5	1
Competitive	50%	21%	16%	9%	4%	1,9	1
Time consume	3%	3%	13%	24%	57%	4,3	5
Addiction	66%	19%	9%	5%	1%	1,5	1
Entertainment	4%	6%	28%	34%	28%	3,7	4

Due to the six reasons given probably not fitting every gamer out there, we also asked users to supplement these reasons with their own. The most common reasons mentioned in these open questions replies were reasons related to performing some other activity. For example, some users mention that they only play games on portable devices when they are out traveling, waiting for the bus/train or waiting for some other main activity. Some users also mention trying new games on these devices due to a technical interest, and keeping up to date in technology.

To further investigate into this matter, we also asked users how often they were performing some other activity while playing games on portable devices (figure 12.25).

Other activity while gaming

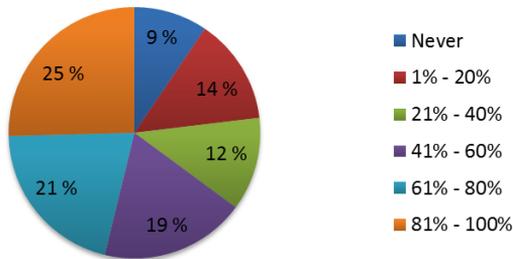


Figure 12.25: How often players perform some other activity while gaming

Looking at the graph one can see that very few people never perform some other activity while playing games on portable devices. Looking at the mean and median values, we find that roughly 50% of the time spent playing, the player is also performing some other activity. If we look at the previous questions, these reasons are elaborated on there.

Table 12.12 compares the alternatives for portable and stationary devices. There is a major difference here. While the median and mean values for portable devices suggest that 50% of the time is played alongside another activity, for stationary devices the same numbers are around 10%, or alternative 2 (1% - 20%).

Table 12.8: How often players perform some other activity while gaming

	Portable	Stationary
Median	4	2
Mean	4,03	2,41
Std. dev.	1,39	1,07
Highest freq	6	2

12.5.1 Age

For the different age groups, there are small differences. One trend coming out of the table below is the median and mean values for the older age groups, which seem to put more importance into relaxation than the younger groups.

Table 12.9: Motivation for playing on portable devices by age

	10-19 yrs		20-29 yrs		30-39 yrs	
	<i>Mean</i>	<i>Median</i>	<i>Mean</i>	<i>Median</i>	<i>Mean</i>	<i>Median</i>
Relax	3,15	3	3,03	2	3,18	3
Social	1,73	1	1,43	1	1,57	1
Competitive	1,86	1	2,06	2	1,87	1
Time consume	4,34	5	4,34	5	4,18	4
Addiction	1,63	1	1,60	1	1,64	1
Entertainment	3,78	4	3,70	4	3,93	4

	40-49 yrs		50-59 yrs		60 + yrs	
	<i>Mean</i>	<i>Median</i>	<i>Mean</i>	<i>Median</i>	<i>Mean</i>	<i>Median</i>
Relax	3,41	4	3,48	4	3,5	3,5
Social	1,31	1	1,65	1	1,33	1
Competitive	1,86	2	2,04	2	1,66	1
Time consume	4,27	5	3,8	4	4,5	5
Addiction	1,17	1	1,6	1	2	2
Entertainment	3,74	4	3,44	3	4,5	4,5

12.5.2 Income

The same trend as for older age seems to be present in the income table below. It seems like respondents with high income use games for relaxation more than others. The income groups between 10 000 NOK and 30 000 NOK also seem to be more competitive.

Table 12.10: Motivation for playing on portable devices by income

	0 - 9 999kr		10 000 - 19 999 kr		20 000 - 29 999 kr	
	<i>Mean</i>	<i>Median</i>	<i>Mean</i>	<i>Median</i>	<i>Mean</i>	<i>Median</i>
Relax	3,06	3	3,20	3	3,06	3
Social	1,55	1	1,59	1	1,45	1
Competitive	1,89	1	2,04	2	2,25	2
Time consume	2,02	5	4,08	5	4,36	5
Addiction	4,02	1	1,51	1	1,64	1
Entertainment	2,61	4	3,65	4	3,72	4

	30 000 - 39 999 kr		Above 40 000 kr		Do not wish to reply	
	Mean	Median	Mean	Median	Mean	Median
Relax	3,16	3	3,48	4	3,35	3
Social	1,50	1	1,32	1	1,71	1
Competitive	1,78	1	1,82	1	2,12	2
Time consume	4,26	5	4	4	4,29	5
Addiction	1,64	1	1,20	1	1,96	1
Entertainment	3,92	4	3,60	4	3,64	4

12.5.3 Gender

For gender distribution we only see one small trend. Not surprisingly the male population claims to use games more due to being competitive than the female population.

Table 12.11: Motivation for playing on portable devices by gender

	Female		Male	
	Mean	Median	Mean	Median
Relax	3,18	3	3,17	3
Social	1,68	1	1,47	1
Competitive	1,83	1	1,98	2
Time consume	4,39	5	4,27	5
Addiction	1,60	1	1,56	1
Entertainment	3,82	4	3,73	4

12.5.4 Social status

Social status does not seem to be a significant factor.

Table 12.12: Motivation for playing on portable devices by social status

	Single		In a relationship	
	Mean	Median	Mean	Median
Relax	2,95	3	3,43	3
Social	1,53	1	1,71	1
Competitive	1,94	1	2,12	2
Time consume	4,45	5	4,21	5
Addiction	1,66	1	1,84	1
Entertainment	3,81	4	4,00	4
	Cohabitant		Married	
	Mean	Median	Mean	Median
Relax	3,11	3	3,53	4
Social	1,40	1	1,46	1
Competitive	1,87	1	1,97	1
Time consume	4,24	5	4,13	4
Addiction	1,36	1	1,43	1
Entertainment	3,58	4	3,74	4

12.5.5 Other activities by groups

Looking at how often players perform other activities while playing on portable devices sorted for the different age groups, income, social status and gender, there are some difference results among the groups. However, we have not found any conclusive patterns in this result set.

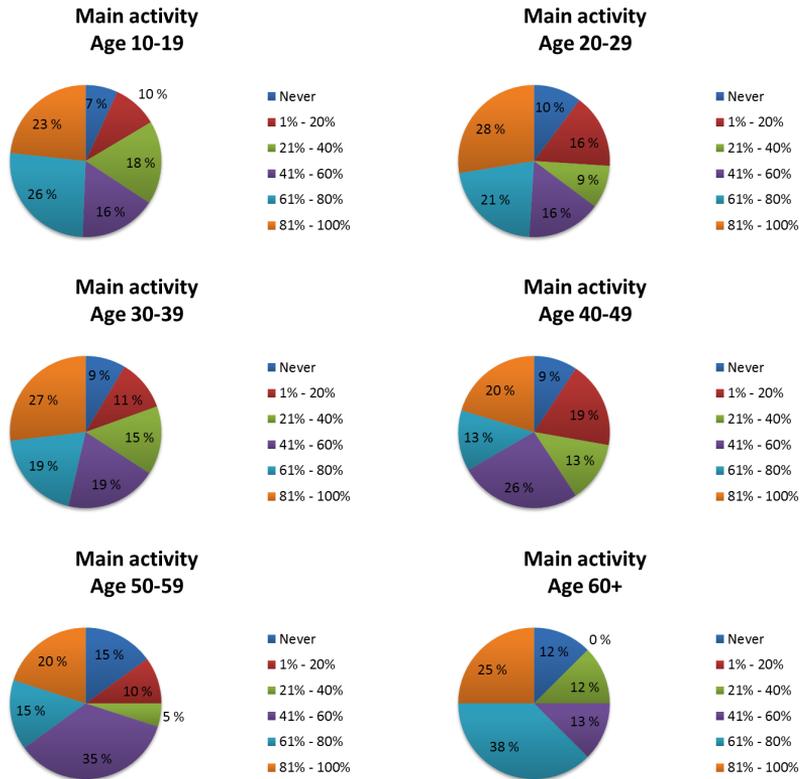


Figure 12.26: Other activity while playing by age



Figure 12.27: Other activity while playing by income

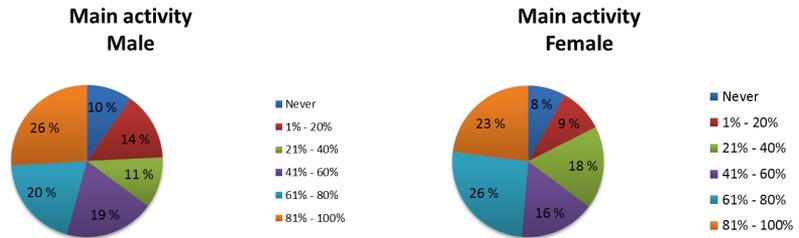


Figure 12.28: Other activity while playing by gender

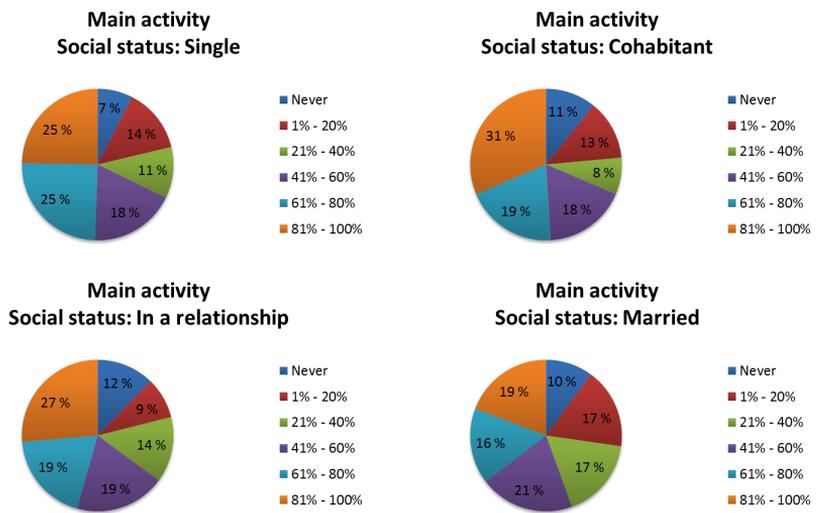


Figure 12.29: Other activity while playing by social status

Attitudes towards pervasive elements

Section 13.1 presents users attitudes towards pervasive games in general. Section 13.2 describe the results from presenting respondents to some concrete concepts, finding their attitudes towards different pervasive elements.

With our first survey having 655 respondents, all these were later asked to answer another survey. 168 of them chose to respond to survey number two, investigating attitudes towards pervasive elements.

13.1 Pervasive elements

Even though survey I was created in order to investigate usage patterns for games, we also included some questions regarding pervasive elements in games. The first pervasive question, question 32, asked users whether they had ever tried a game where their location was a factor. 12,5% of the respondents had tried such a game. The participants were also asked to elaborate when the answers was yes to the question. Open replies are summarized in table 12.13 below.

Table 13.1: Location games elaboration

Nintendo Wii games	Walk in real life to walk in game
Mass Effect 3	Different games with geotagging
Killer game	Games where language are adjusted to location
Gowalla	The merchant (iPhone)
Garmin GPS games	Foursquare
TurfWars	Flight simulator
Geocaching	Ocarina (iPhone)

Question 33 asked the users if they had tried games in which mixed real and virtual world elements (example: real world weather is reflected in game etc). 20.7% of the respondents answered that they had tried such a game. Respondents were asked to elaborate on their answer in this question as well. The replies are summarized in table 12.14 below.

Table 13.2: Location games elaboration

Internet polls reflected in game	Flight Simulators
Real day/night cycle	Tiger Woods 10 (real weather)
Car simulators (weather)	Burnout Paradise (time of day)
Black and White (Weather and time of day)	Time of day synced
Google Earth War	Games using cameras to move elements in game
Battlefield 2142 (real company ads)	The Merchant (Geographical similarities)
Oblivion mods	World of Warcraft
Zombie Run (Android)	Football Manager
Local time and weather	

In order to see respondents attitudes towards these sort of elements, they were asked how a games value in general would change with these real and virtual world mixing elements (Q34). From figure 12.30, we see a general positive attitude towards these sorts of elements, with the graph shifted to the right.

Attitudes towards pervasive elements, Non-gamers

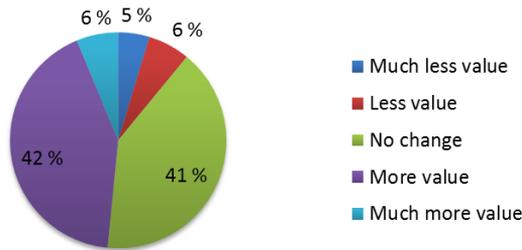


Figure 13.1: Players attitudes towards pervasive elements

With the mean and median values from table 12.15 being around alternative 4

(positive), one can say that the general attitude towards these sort of elements among the respondents were positive.

Table 13.3: Players attitudes towards pervasive elements

Median	4
Mean	3,61
Std. dev.	0,68
Highest freq	4

On this question we also asked users to give their comments in addition to the pre-defined option, and it was the question with the most open text comments in the survey. Among the respondents that were positive to pervasive elements, there are several reasons mentioned. Some users say that they would like to experience a more dynamic game, and that pervasive elements could help this. Other users mention that it would add another dimension to games, giving the user more possibilities for interaction and ownership to the game story. Games feeling more alive were another argument. Some respondents replied that the they feel the game experience would feel more realistic. More tailored game experiences were mentioned along with respondents that would like to see real world events affecting their game.

To summarize, respondents answering that this would affect a games value in a positive manner, feels that it would be a more dynamic, realistic and user influenced game experience.

For the ones that felt these elements for have a negative effect on game value, many users said that they play games as an escape from real life, and therefore would not like this mix of real and virtual elements. Many respondents felt that this adds too much complexity, expressing a wish for simple games. Some expressed worries related to implementation, and that the actual implementation were to important to being able to answer in a positive manner to this question.

Most of the respondents adding comments to the question was positive.

13.1.1 Age and income

Looking at the graph for the different age and income groups, we can see that the two oldest age groups are a bit different than the others. However, as explained earlier, there are very few responses in that category and difficult to draw any conclusions. There are some minor differences between the other groups as well, however, not consistent enough to see any patterns.

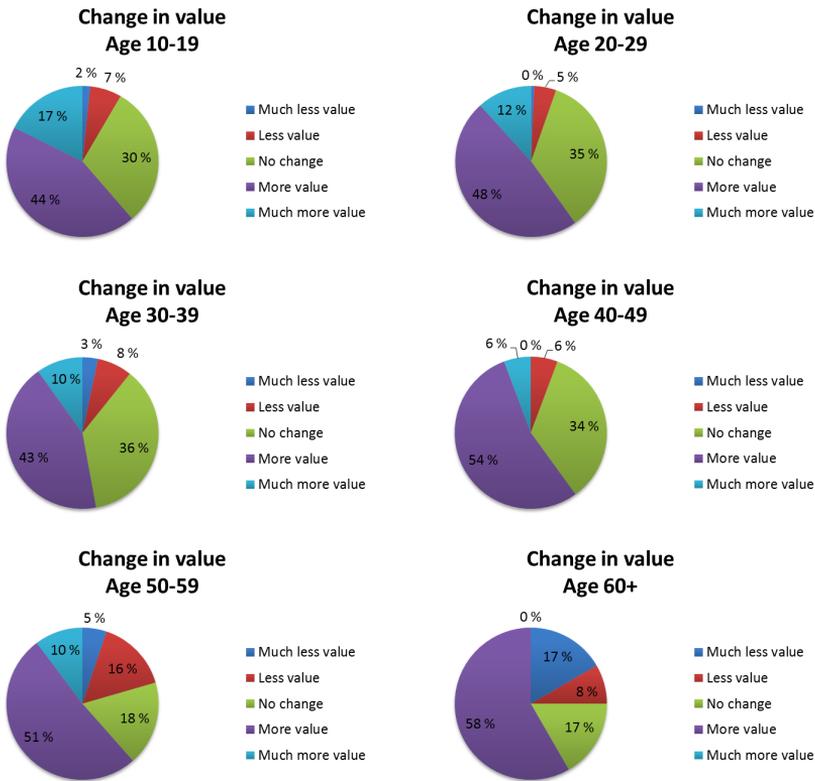


Figure 13.2: Players attitudes towards pervasive elements by age



Figure 13.3: Players attitudes towards pervasive elements by income

13.1.2 Gender

It seems that females have more positive answers than the male population. It is pretty much the same for the “very negative”, “negative” and “positive” options, but for “no change” and “very positive” females have a higher answer ratio on very positive.

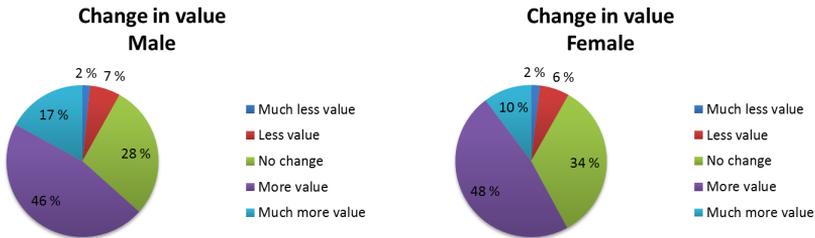


Figure 13.4: Players attitudes towards pervasive elements by gender

13.1.3 Social status

Social status have no major patterns, all the groups seem to have about the same reply pattern to this question.

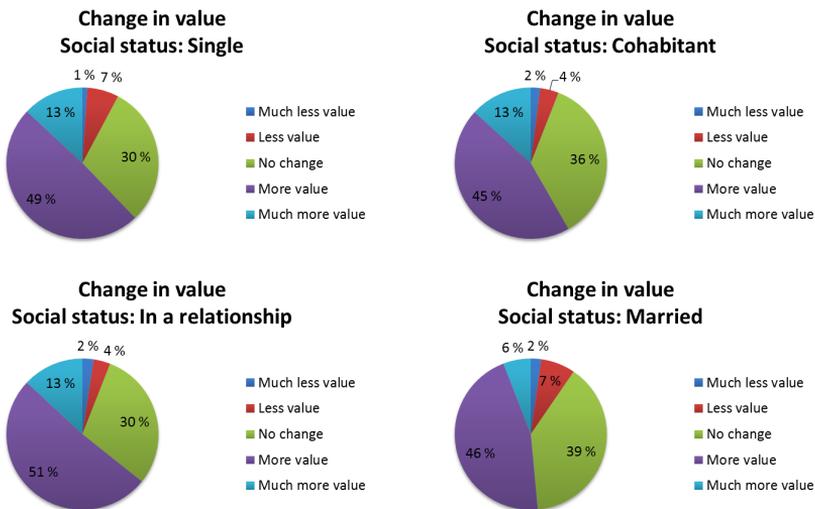


Figure 13.5: Players attitudes towards pervasive elements by social status

13.1.4 Non-gamers

It is also interesting to look at the non-gamers attitudes towards the pervasive elements described. The non-gamers are the respondents that currently does not play games on stationary nor portable devices. Figure 12.35 shows the responses.

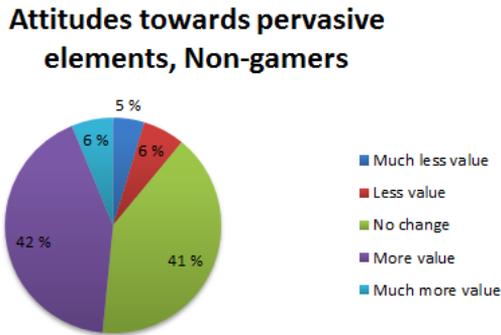


Figure 13.6: non gamers attitudes towards pervasive elements

Looking at this graph, only around 11% of the respondents believes that pervasive elements will have a negative effect on game value. Adding in the no change group, around 52% of the respondents does not believe that pervasive elements will bring additional value to games. That means that around 48% of the non-gamers believe that pervasive elements would bring more value to a game.

13.2 The concepts

In Survey II, we ask about five different game modes in each concept, an explanation of the modes follows:

As is: against computer, no playing with others.

Solo PvP: players play on their own against other human players.

Team PvP: teams of human players against other teams of human players.

Solo PvP event: same as the other Solo PvP, except the player meet others players in real life to play.

Team PvP event: same as the other Solo PvP, except the team meet others teams in real life to play.

In survey two, we first created the base concept as a baseline for the other concepts. This concept was designed to be fairly neutral. We can see from the figure above that the concept was indeed pretty neutral in itself, with many replies centered around the neutral options. These data was collected by determining the average answer to each question (Q1.1, Q1.2, Q1.3, Q.1.4 and Q1.5). Playing alone against others is not very popular, neither as a normal game session or when playing in the real world. Playing the game as a team against other players is popular, however, and more so when doing it in the real world.

When we look at the data for the other concepts, the first thing we see is that the augmented reality concept was the least positive, having a overall negative contribution to the game. The variance of the AR over the other questions is

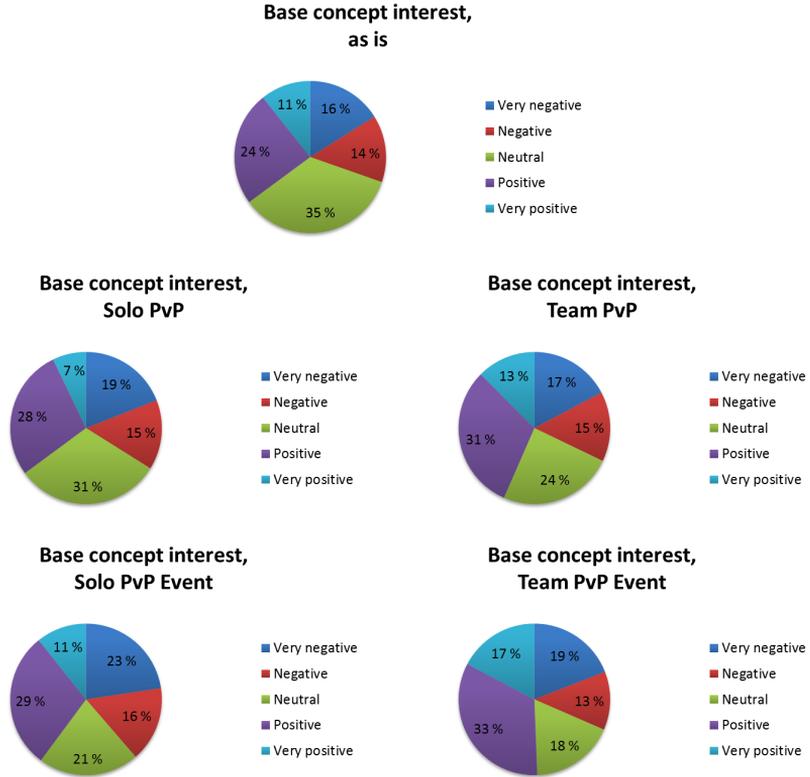


Figure 13.7: Interest for base concept

consequent with the variance of the baseline test. Location based games seem to be the most popular add on, but only when applied to a situation where you play in the real world in a Team PvP situation. It mostly conforms to the category variance of the base concept over the other categories as well, except that the Solo PvP event seems to be more popular than the Solo PvP event. For the proximity concept, we see the survey participants like this idea the best as it is, while it shows the roughly the same spread for the other categories, except for the solo PvP event, which is unexpectedly low compared to the other events.

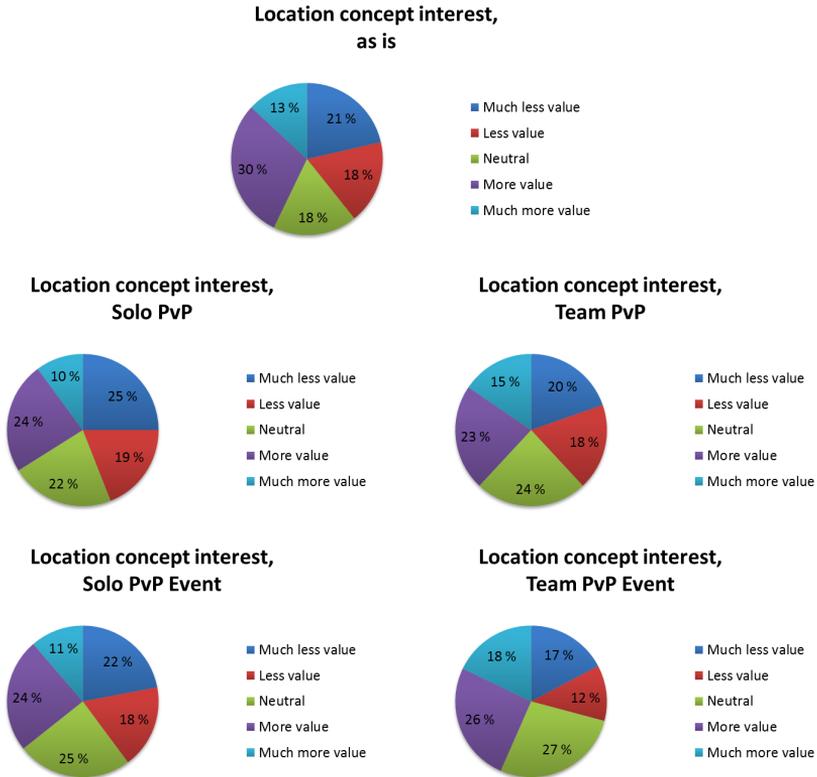


Figure 13.8: Interest of location concept

13.2.1 Concept interest by gender

Females are generally more interested in all of the game types except “Team PvP”, where males are more interested. It is interesting to see that the females that took the test answer positive to most concepts, while the males are predominantly negative to the concepts, with an exception from the team concepts.

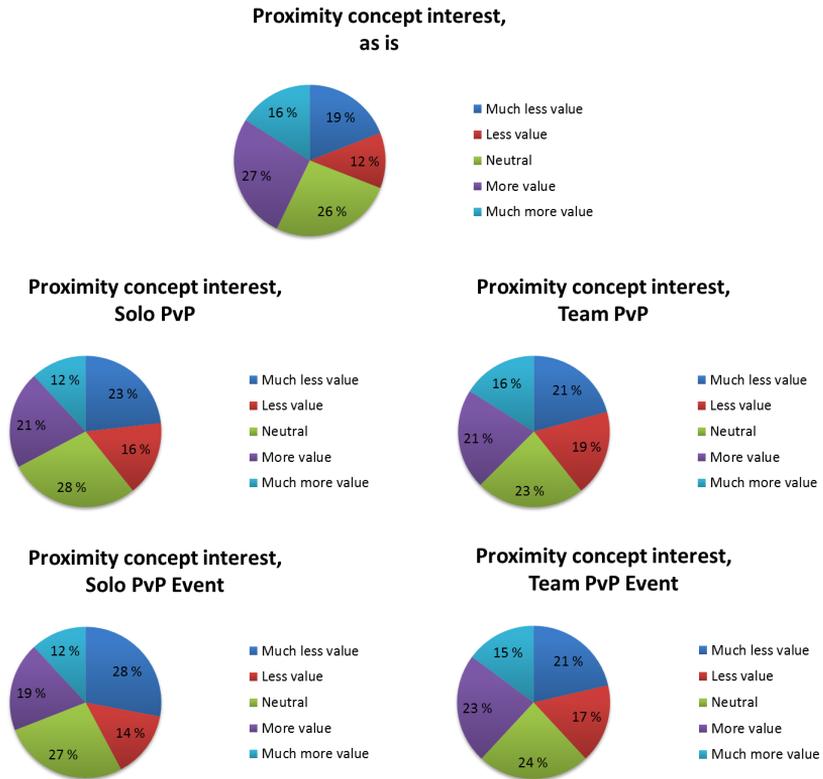


Figure 13.9: Interest of proximity concept

When looking at the Location concept we can see that females are more interested in the real world mixed versions of this concept, especially the Team PvP event, while the rest of the categories are very similar. Females are a little bit more interested in Team PvP and the concept itself, while males are a little bit more interested in the Solo PvP version.

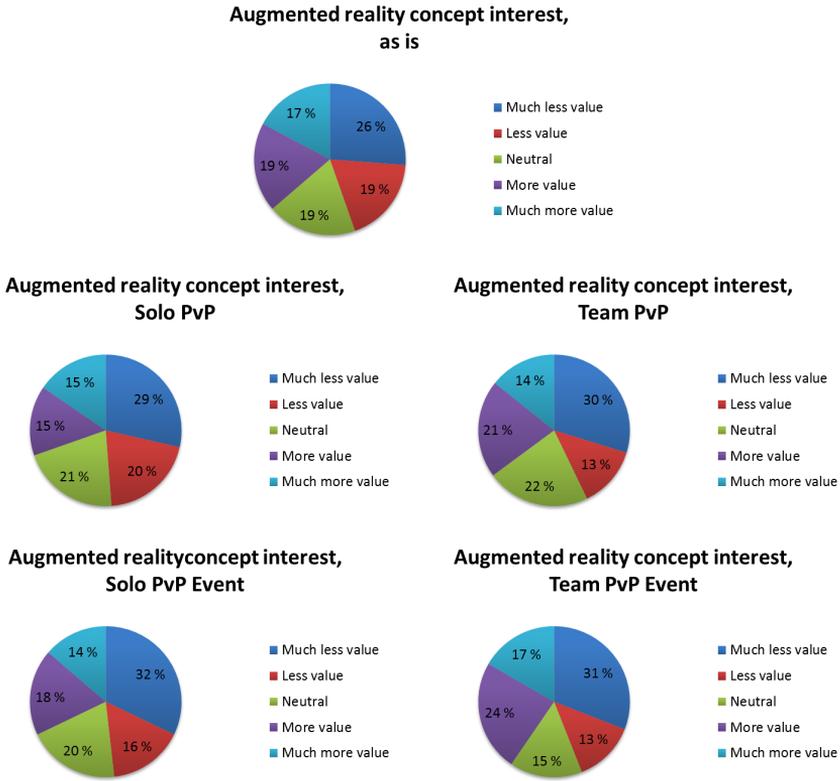


Figure 13.10: Interest of Augmented Reality concept

For the proximity concept, we can see a tendency for females to like the concept itself more than men. Both sexes like the concept more than the base concept, however. Males like the Team PvP and Solo PvP event option some more than females, while females like the Team PvP event option a bit more than males.

We have previously seen that the AR concept was the least popular. No gender had a positive preference for any of the AR options. Females have much stronger dislikes for all the AR options than men.

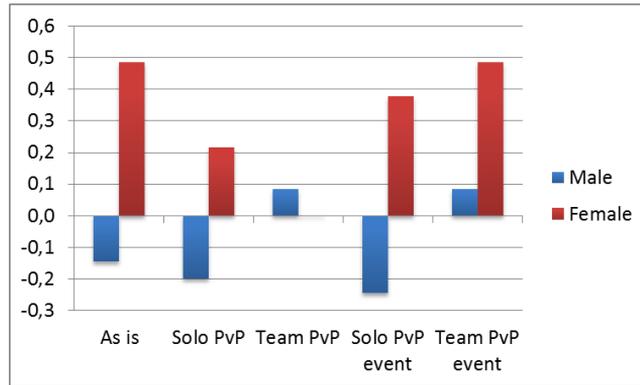


Figure 13.11: Base concept interest by gender

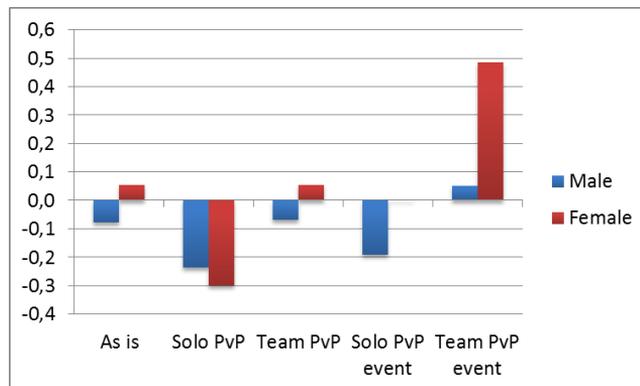


Figure 13.12: Interest for the location concept, by gender

13.2.2 Concept interest by income

The base concept as is most interesting for the first and fourth income groups, with the 20k group being neutral, the 10k group being slightly negative and the above 40k and unknown group being uninterested. An interesting correlation for all the “by income” data we have is that the 40k+ group and the unknown

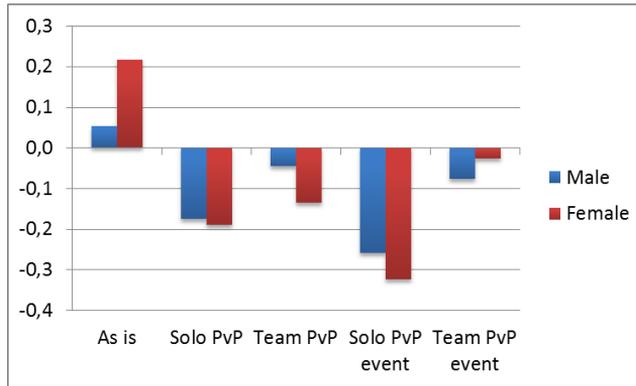


Figure 13.13: Interest for the proximity concept, by gender

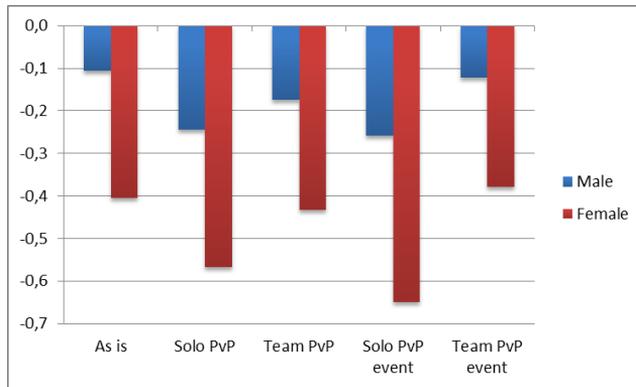


Figure 13.14: Interest for the AR concept, by gender

group seem to be just about identical for all values. It could be that most of the people who did not want to answer the input question should belong to the 40+ group, or there could be another correlation we do not know about. For the PvP option, most groups are negative, except the 30k group, who is positive. For the team PvP option, the first group is very positive, and the 30k group is positive, while the rest are negative. For both event options, the 40k+ and unknown groups are extremely negative. The first income group is positive for the Solo PvP event, and extremely positive for the Team PvP event. The

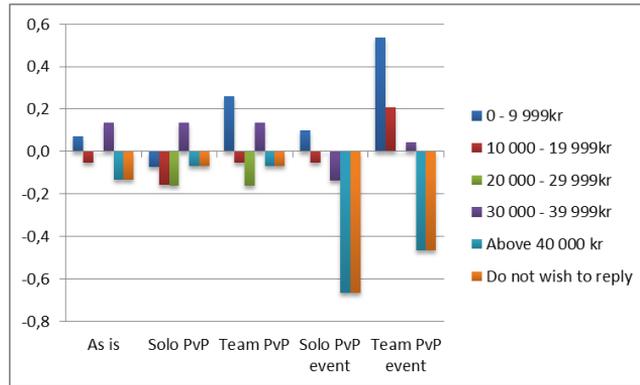


Figure 13.15: Interest for the base concept, by income

10k group is slightly negative for the Solo PvP event, but quite positive to the Team PvP event. the 20k group is neutral to both, and the 30k group is negative to the Solo PvP event, but slightly positive to the Team PvP event.

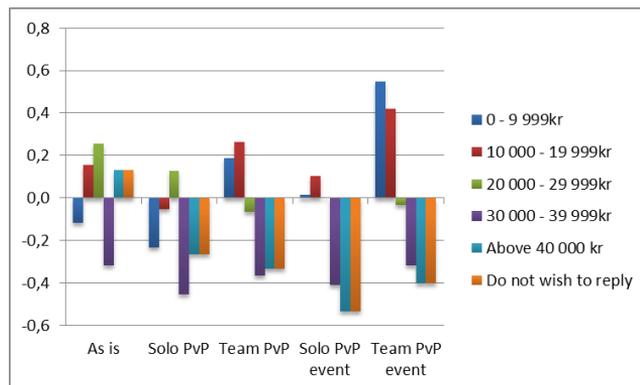


Figure 13.16: Interest for the location concept, by income

The location concept itself is interesting for the 10k, 20k, and 40k+ groups, but negative for the first group and very negative for the 30k group. The 40k

(and unknown) group, as well as the 30k group, is very negative to all the other options for the location concept. The 20k group is positive to the Solo PvP option, but slightly negative or neutral for the other options. The first and second groups are the only ones positive to the Team PvP option and the event options, both being quite positive to the Team PvP option, slightly positive to the Solo PvP option, and very positive to the Team PvP event option.

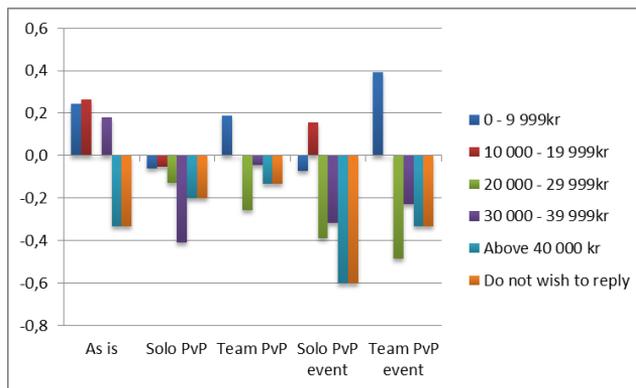


Figure 13.17: Interest for the proximity concept, by income

The first income group is overall the most positive to the proximity concept. They like the concept as it is, and the Team PvP option, and like the Team PvP event very much. The second group are mostly neutral to all options, but slightly negative to the Solo PvP, and quite positive to the concept itself, as well as the Solo PvP event option. The 20k group are neutral to the concept itself, but gradually more negative to the other concepts, being negative to Solo PvP, a bit more negative to the Team PvP option, and very much more negative to both event options. The 30k group likes the base concept, but dislikes all the options. They dislike the Team PvP option a bit, but dislike all the other options (Solo PvP, and both event options) very much. The 40+ (and unknown) group is negative to the concept itself and all the options. Being very extremely negative to the Solo PvP option.

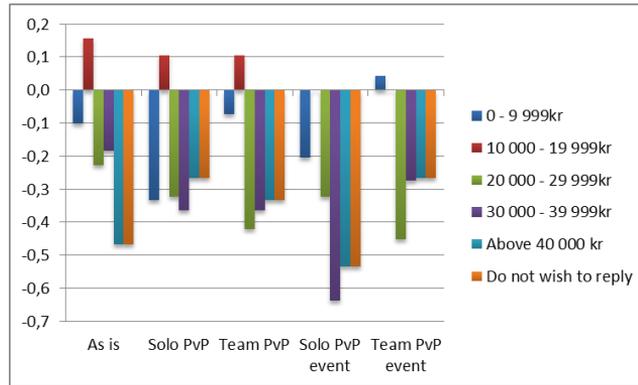


Figure 13.18: Interest for the AR concept, by income

When it comes to the augmented reality concept, the 10k group is the only income group who likes the main concept. They also like both non-event options, but are neutral to the event options. The first income group are negative to all but the Team PvP event option, which they are slightly positive to. The rest compare roughly to the overall statistics.

13.2.3 Concept interest by age

For the base concept, we can see that the first age group (10-19 years) enjoy the PvP options much more than the other options. The second age group (20-29 years) is much more moderate, and stay close to the 0 axis for most of the options. They slightly like the concept as is, the Team PvP option and the Solo PvP event option, and slightly dislike the Solo PvP option. They do however enjoy the Team PvP event option much more than the other options, almost as much as the first age group. The third age group (30-39 years) dislikes all options of the base concept, with special dislike for the Team PvP options. The fourth age group (40-49 years) likes the first three options very much, but does not like the real world event options. The last age group (50-59) likes the option as is, is neutral to the Team PvP option, and dislikes the Team PvP

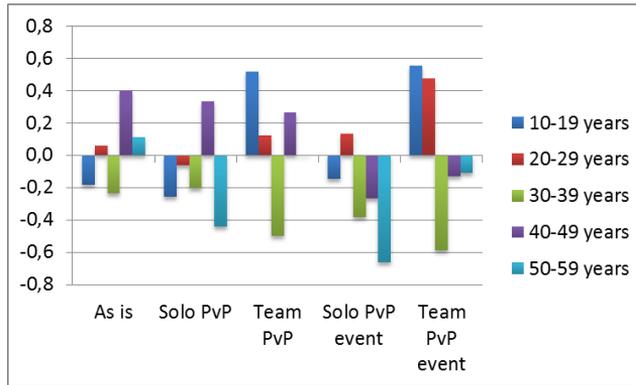


Figure 13.19: Interest for the base concept by age

event option some, but dislikes the Solo PvP options strongly. The 60+ age group was cropped, as it had only a single answer.

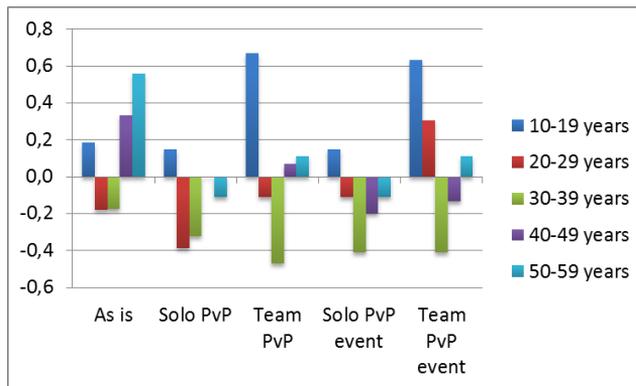


Figure 13.20: Interest for the location concept, by age

Here we can see the first age group is as usual much more interested in the Team PvP options, but this time they overall like the options. The second age

group is generally negative to the concept, especially when played as Solo PvP, but positive when played as a Team PvP event. The third age group answers much the same as the last age group, being negative to all options. The fourth age group is positive to the concept itself, but not as a solo PvP event or team PvP event. They are neutral towards the solo PvP option, and slightly for the team PvP options. The last Age group is very positive to the project itself, slightly positive to the concept when played as a team, but negative to the solo PvP options.

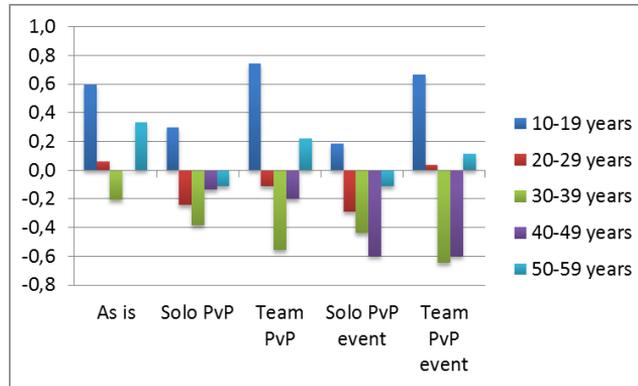


Figure 13.21: Interest for the proximity concept, by age

As with the base and location concepts, the first age group is predominantly positive. They are very positive to the general concept, and especially played as a team. The second group is slightly positive to the concept itself, but negative to everything but the Team PvP event. The third age group are as usually very negative to all options. The fourth group are neutral to the concept itself, and negative to everything else, slightly negative to the solo/team PvP options, and very negative to the event options. The last age group is positive to the base concept, and likes both team options, and slightly dislike the solo options.

The AR concept was generally disliked, both in the general comparison and the gender comparison. From the figure above we can see there are strong negative

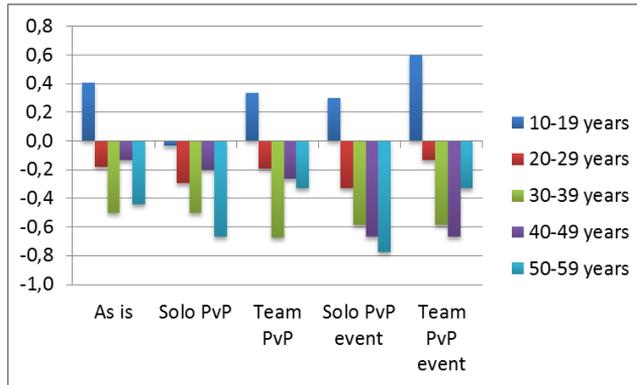


Figure 13.22: Interest for the augmented reality concept, by age

tendencies for all age groups except the first. The first age group is strongly for all options but the Solo PvP option.

13.2.4 Concept interest by social situation

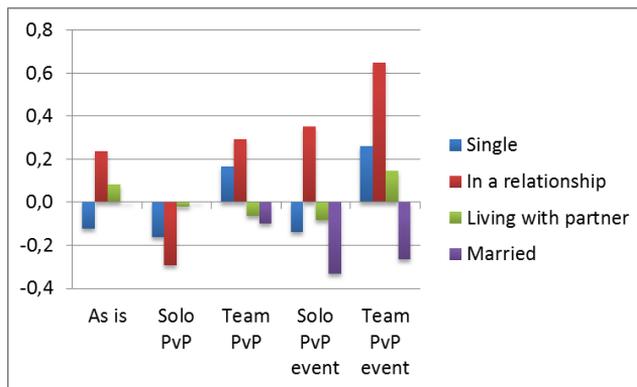


Figure 13.23: Interest for the base concept, by social status

When we look at the social situation, we see quite a divided picture. The subgroups are very different. Singles do not like the base concept itself, or the solo PvP options. They do however like the team options. People in a relationship are more likely to like the concept itself, and are the most positive for all concepts except the Solo PvP option, which they dislike the most. People who live with their partner are a bit positive to the base concept itself, and when played as a team PvP event, but slightly dislike the other options. Married people are neutral to the concept itself, and when played as a solo PvP. They are negative to the other options, especially the event options. Some of this could be due to the correlation between age and marriage, as we have seen a inverse correlation between interest in all the concepts and age.

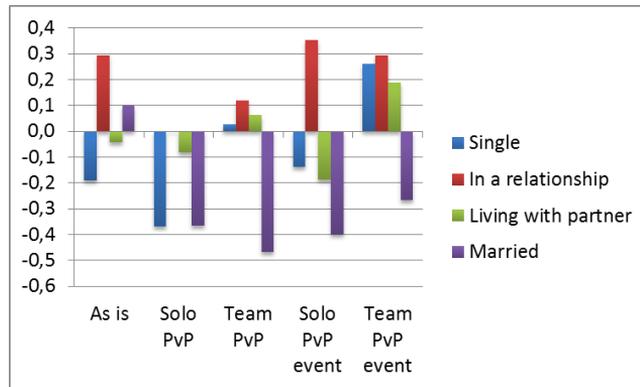


Figure 13.24: Interest for the location concept, by social status

The location concept is mainly disliked by singles, scoring very negatively on the as is and solo PvP options. Singles do however enjoy the Team PvP event option. People in a relationship seem to enjoy the location based concept very much, scoring very high on the event options and the concept itself. They are neutral on the Solo PvP option, and slightly positive on the Team PvP option.

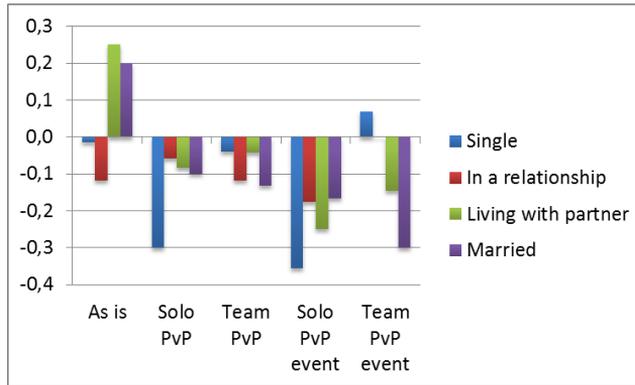


Figure 13.25: Interest for the proximity concept, by social status

The proximity concept scores very differently from the location concept. Here the married couples, and people who live with their partner are the most positive to the concept. The singles are slightly negative to the general concept and team PvP option, and slightly positive to the Team PvP event. As for the Solo PvP options, they are extremely negative. People in a relationship are generally negative to all concepts, but neutral to the Team PvP event. People who live with their partner are the most positive to the general concept, but are slightly negative to the PvP options, and very negative to the event options. Married people resemble those living with their partners, they like the general concept, but none of the options. They generally dislike the solo PvP event option more than the ones living with their partners, and dislike the team PvP event less (but still much).

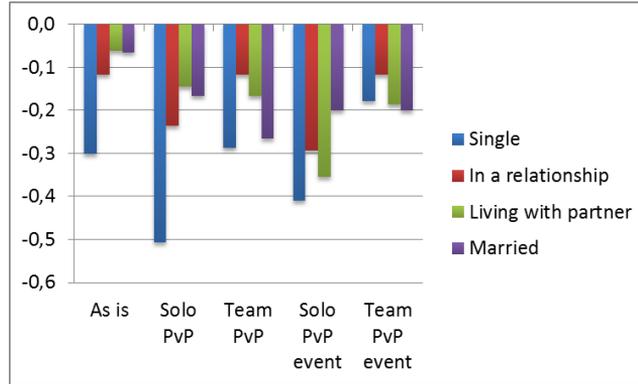


Figure 13.26: Interest for the augmented reality concept, by social status

As we have seen with the other groups, the AR option is not very popular. The ones who dislike this concept the most seem to be singles, which is interesting, considering that the youngest age group (traditionally containing the largest percentage of singles) was the most popular. As with the other concepts and groups, the solo options are the least popular. Interestingly, the married people are the most moderate in this segment.

13.3 Game elements

One of the main goals of this project is to provide a tool for developers by determining what pervasive elements people would like to see in games. Therefore a part of survey II was dedicated to asking the users what game elements they felt were important for a game, and what elements would create a negative experience. By ranking each element from 1 (Element would lessen the experience) to 5 (Element would better the experience), where 3 is neutral, this would give us an idea of the popularity of the elements.

13.3.1 Temporal elements

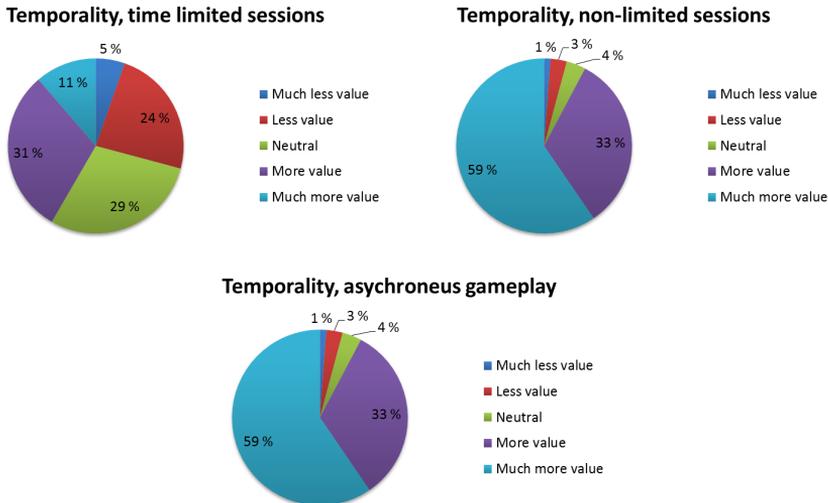


Figure 13.27: Popularity of the temporal elements

We defined three temporal elements: Limited time describe a game where every games session has a maximum game length, and the game session must be completed for the player to gain score. The freedom of time option is described as a game where the user may start and stop the game arbitrarily, and the score/game state is saved at closing. The asynchronous option describes the game running on a server, and messages being sent to the mobile device when something happens in the game, prompting actions from the user.

When we look at the general collated data from this section, we can see that people do enjoy games with limited sessions, but very much prefer games that can be played for arbitrarily am mounts of time, at any time. Asynchronous games are generally disliked, however.

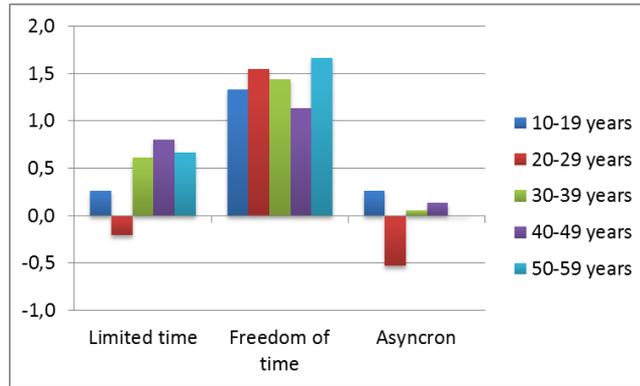


Figure 13.28: Popularity of the temporal elements, by age

When grouped by age, we can see that there is not much difference in what the age differences prefer. They all prefer the “Freedom of time” option, although there is a tendency for the 30+ age groups to enjoy the limited time option more than others. On another note, the second age group (20-29 years) is the only age group to dislike any of the options, having a slight dislike for the “Limited time” option, and a strong dislike towards the asynchronous option.

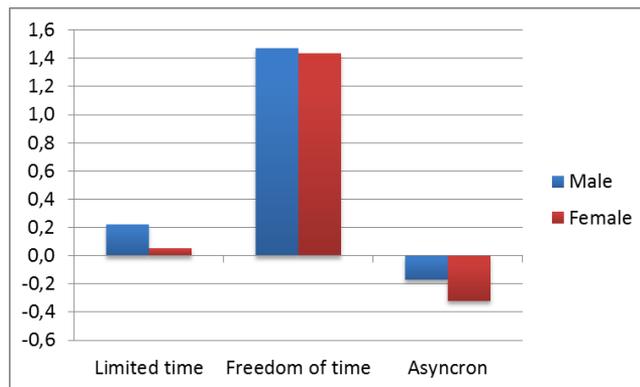


Figure 13.29: Popularity of the temporal elements, by gender

The genders are very similar when it comes to the temporal elements. Females tend to like the limited time and asynchronous options less than males, but the trends are the same.

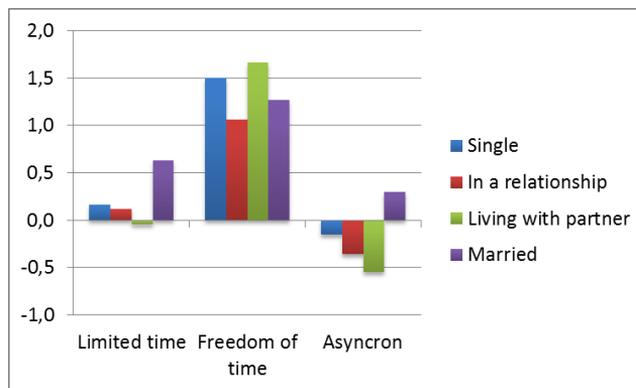


Figure 13.30: Popularity of the temporal elements, by social group

When we look at the different social groups, we still see the same trends for all groups. Married people are much more likely to enjoy the limited time option, however, and are the only group to be positive to the asynchronous option. People who live with their partner are the ones who most enjoy the “Freedom of time” option, and at the same time dislike the asynchronous option the most.

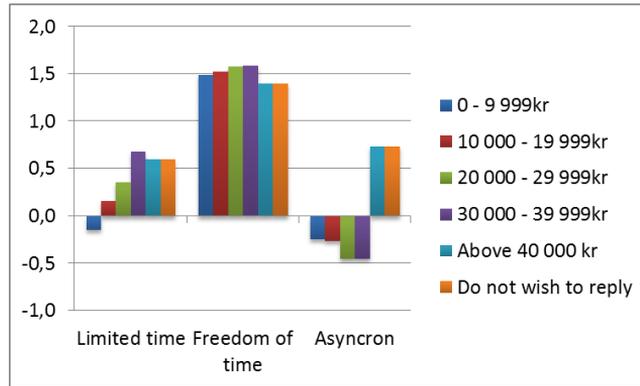


Figure 13.31: Popularity of the temporal elements, by income

Income wise, the numbers are fairly stable, with all income groups greatly favoring the “Freedom of time” option. The lower income groups favor the limited time option the least. When we look at the asynchronous option, the above 40k group and the unknown income group are the only ones who are positive to that option.

13.3.2 Mobile elements

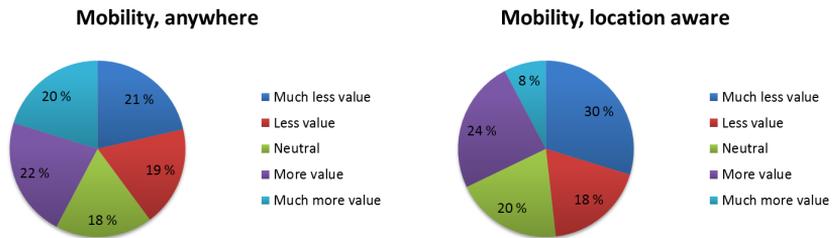


Figure 13.32: Popularity of the mobile elements

Looking at the mobile elements, we can see that people slightly like the idea of being able to play anywhere, but most dislike the idea of location aware games, where the player has to be in a specific place to undertake an action.

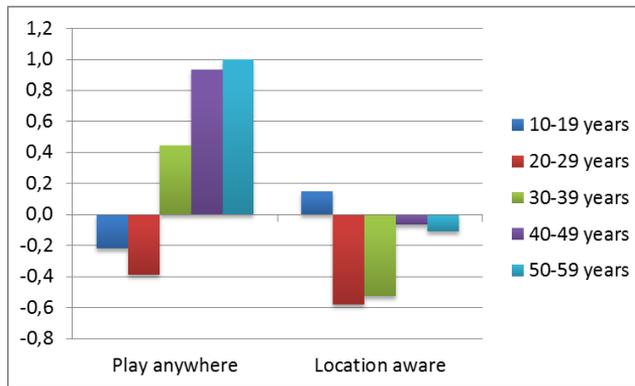


Figure 13.33: Popularity of the mobile elements, by age

When we look at the age groups, the two youngest age groups are negative to the idea of being able to play anywhere. Since the concept of mobility often is a trade off between performance/hardware and mobility, this could be some of the reason for the negativity towards mobility. The other age groups are increasingly positive. When it comes to location aware games, the youngest age group is the most positive. The two next age groups (20-29 and 30-39 years) are the most negative to location aware elements, while the 40+ segment very slightly dislikes it.

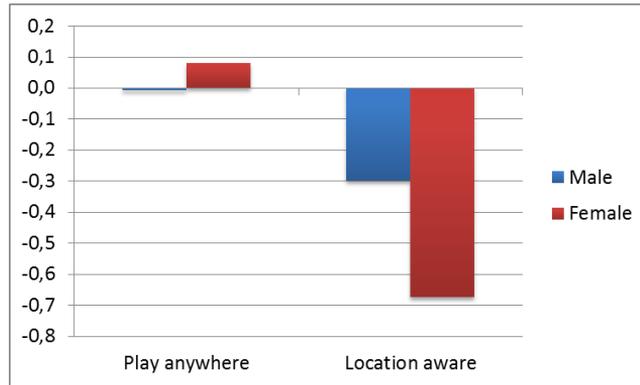


Figure 13.34: Popularity of the mobile elements, by gender

When it comes to gender, females are slightly more likely to appreciate being able to play anywhere, but dislike the location aware option the most.

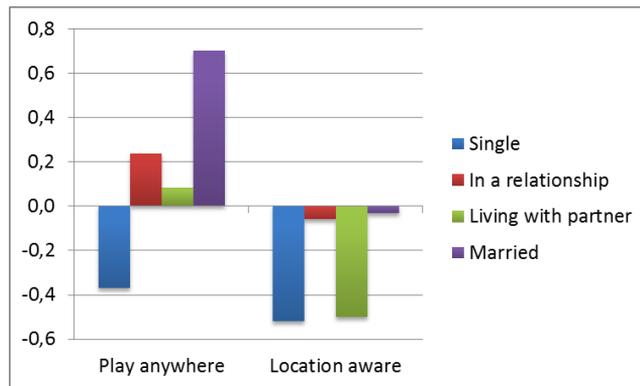


Figure 13.35: Popularity of the mobile elements, by social status

People who are single are by far the least likely to appreciate being able to play anywhere, while married people are the most likely to enjoy being able to

play anywhere. It is also interesting to note that the most negative to location aware elements are single people and people who live with their partner.

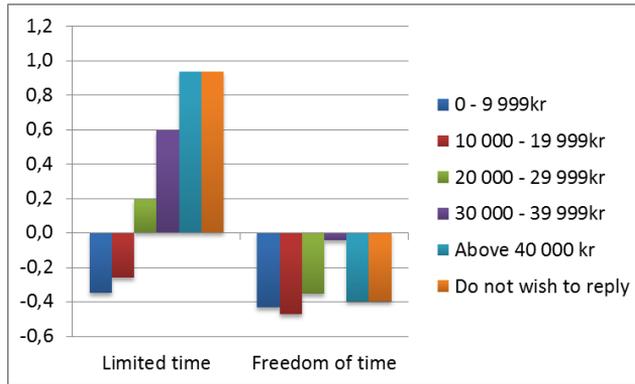


Figure 13.36: Popularity of the mobile elements, by income

When it comes to income, the lowest income groups are the least likely to enjoy the play anywhere option. All income groups except the 30-39k group are strongly against location aware elements. The 30-39k group are just slightly against location aware elements.

13.3.3 Input elements

This part of the survey gauged attitudes to different methods of input. Visual input describes a system which can interpret video images of the user, where gestures or movements are used as input for the system. Likewise the voice input option describes a system where audio is recorded and interpreted for use as input. The bio input option describes a system where the system is given knowledge of different biological human outputs, like pheromones, heart rate etc. and reacts to these. The location input changes the game when the user changes location. The object input uses real world objects to control the game.

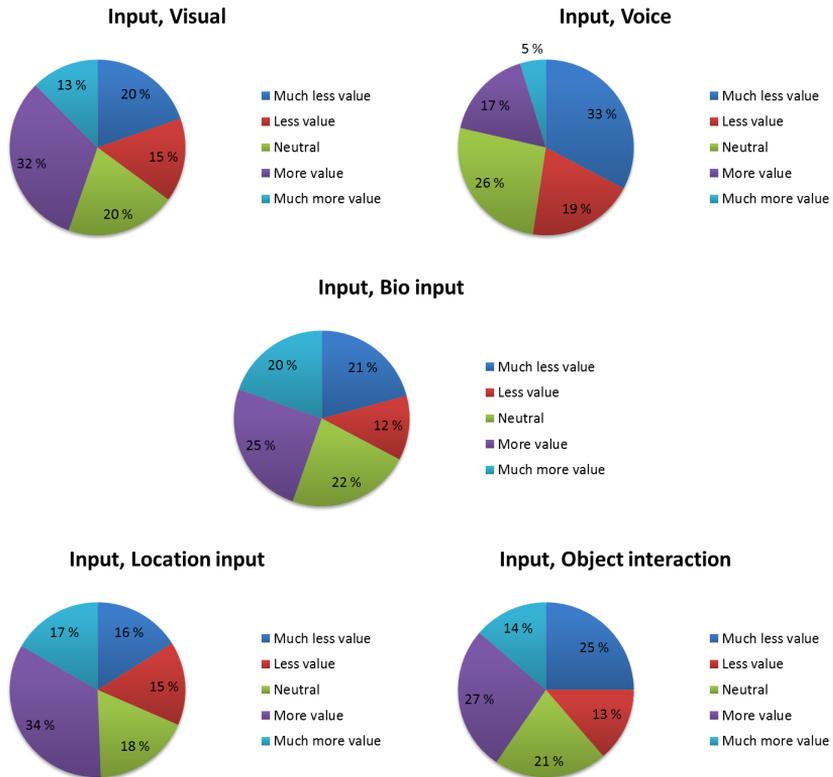


Figure 13.37: Popularity of the input elements

The visual input option is overall slightly liked, while the bio input and location input gathers some more interest. The voice input option is perceived extremely negatively, with a -0.59 out in the space of [-2,2]. In the comments, one participant commented that he disliked voice input because he had bad experiences with them in the past. Of the elements in this section, only visual, voice and location input has seen mainstream usage. The location element is fairly simple to implement, and works pretty well with today's technology, but the visual and voice input of current day systems are crude at best. Visual input systems of today mainly look at movement, and do not allow complicated

controls. Voice systems on the market today are crude and misinterpret many dialects. This may be part of the reason why especially voice input is rated this low in this survey.

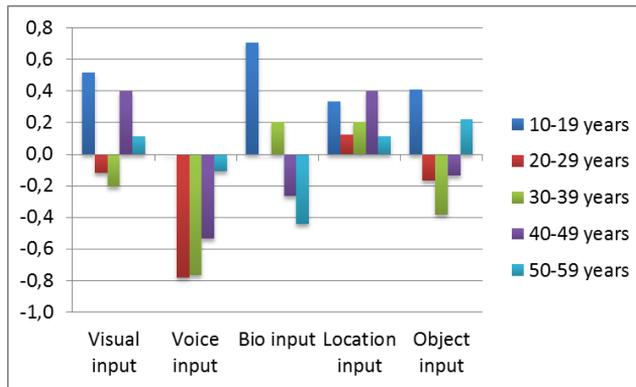


Figure 13.38: Popularity of the input elements, by age

Looking at this section grouped by age, we see a lot of scattering. The youngest age group is by far the most overall positive to the options, being very interested in bio input and visual input. They are also the only ones who are neutral (and therefore not negative) to voice input). The second age group is slightly negative to visual, very negative to voice, neutral to bio input, positive to location input and negative to object input. The third group is very similar to the second group, but even more sceptical than the second group when it comes to object input. They are also more interested in bio input than all the others except the first group. The fourth group is very interested in visual input and location input, but sceptical to the others, especially voice and bio. The last group is a bit positive to visual input, a bit negative to voice, the most sceptical to bio input, moderately positive to location and interested in object input.

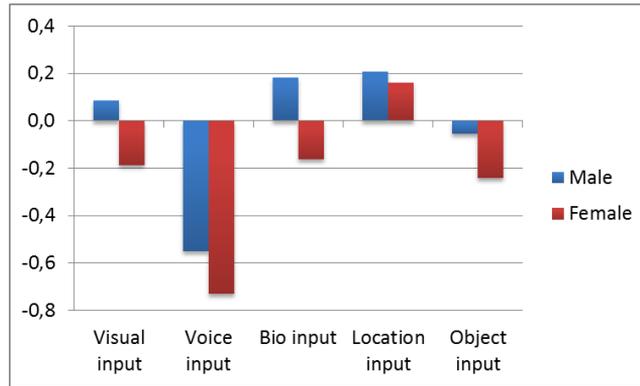


Figure 13.39: Popularity of the input elements, by gender

When it comes to gender, males are much more positive to visual and bio input than females. They are also less negative to voice and object input. They are a bit more interested in location input, which is the only input the females are positive to.

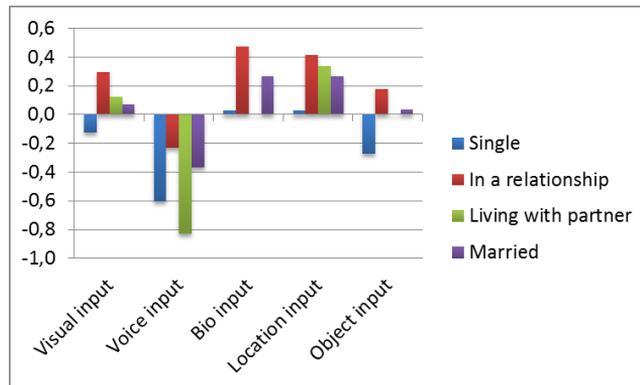


Figure 13.40: Popularity of the input elements, by social status

Singles are negative to all options, except the bio and location inputs. People

in a relationship are the most positive, being very positive to bio and location input, and positive to object and visual input. They are also the least negative to voice input. Cohabitants are the most negative to voice input, but neutral to bio and object input. They are slightly positive to visual input and positive to location input. Married people are slightly positive to visual input, negative to voice, positive to bio and location input, and slightly positive to object input.

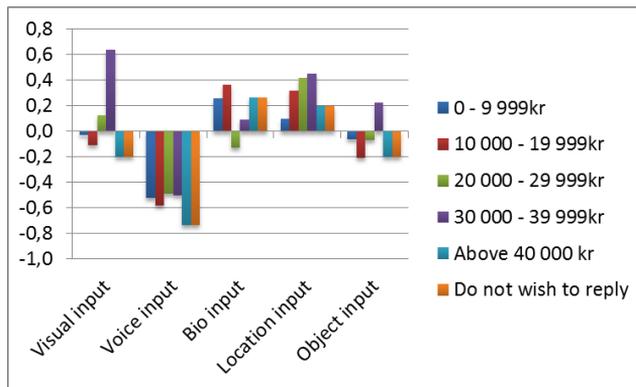


Figure 13.41: Popularity of the input elements, by income

Voice input is disliked by all income groups. The visual input and object input options are the most scattered, where in both, the above 40k and unknown groups are negative and the lowest group is slightly negative. The 30k group is extremely interested in visual input, and interested in object input. The 10k group slightly dislikes visual input and dislikes object input. When it comes to bio input, it is most popular with the two lowest groups, the 40k+ group and the unknown group. The 30k group is slightly interested, while the 20k group dislikes it.

13.3.4 Output elements

Just like with input elements, we need to gauge peoples reactions to different methods for output to the user. The different outputs we asked for input on

was: Standard visual output, where the user is given information from the game using a visual aid like a screen. Augmented reality, where the system mixes a video feed from the real world with computer generated images. Feedback by sound, where the user is stimulated by sound effects and changes in music. Force feedback, where the user is given information from the game by controller shaking. Object output, where the game moves objects around to tell the player what is happening in the game.

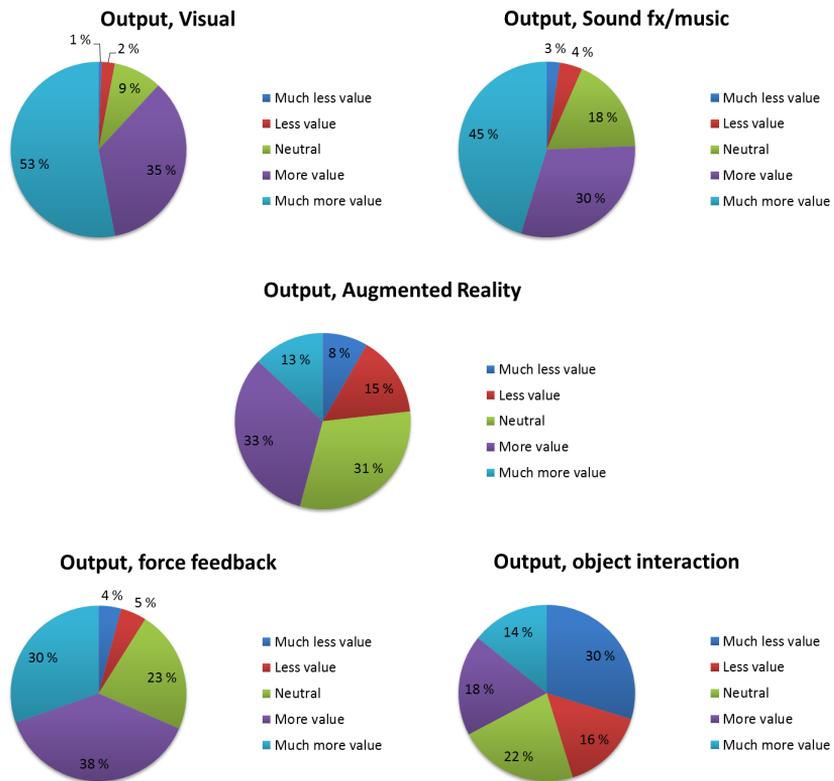


Figure 13.42: Popularity of the output elements, general

The standard methods, Visual and Sound are very popular. Another much

used output method, force feedback, is also popular. Even though the AR option in part one of survey II was generally disliked, it is clear from these statistics that the participants of the survey are generally positively disposed to AR. It may therefore be our use of AR that is to blame for the outcome of part one. Object output is the only output method that is perceived negatively by the participants.

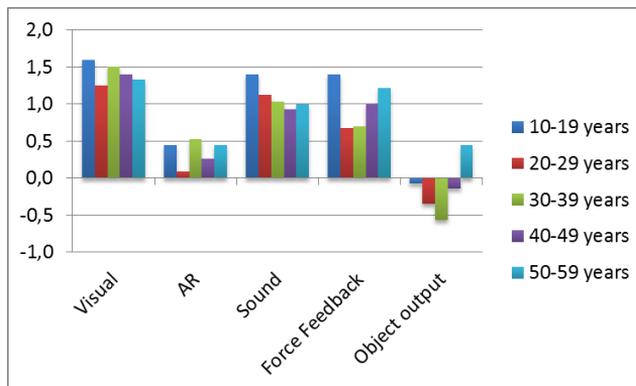


Figure 13.43: Popularity of the output elements, by age

When we look at the age composition for these questions, we can see that the age groups fairly agree for most of the questions. They all like the visual and sound outputs. The youngest group is the most positive to force feedback, while the rest of the groups are slightly more interested by age. The AR output system is divided, with the first, third, and last age groups being the most popular. With object output, grow gradually negative in the first three age groups, while the fourth group is only slightly negative, and the last group is positive.

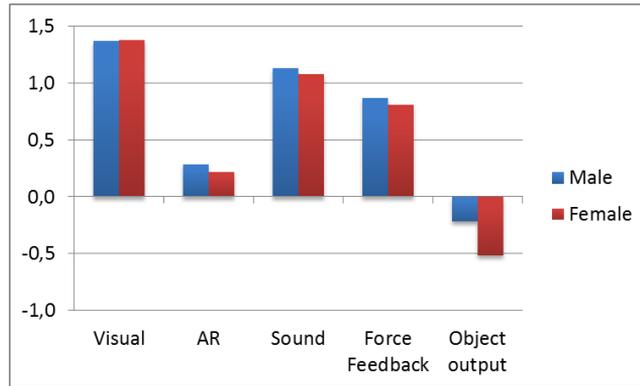


Figure 13.44: Popularity of the output elements, by gender

Here we can see that the genders are fairly in agreement in all questions, except the object output, where the females are more negative than the males. The females are also slightly more negative to AR, sound and force feedback.

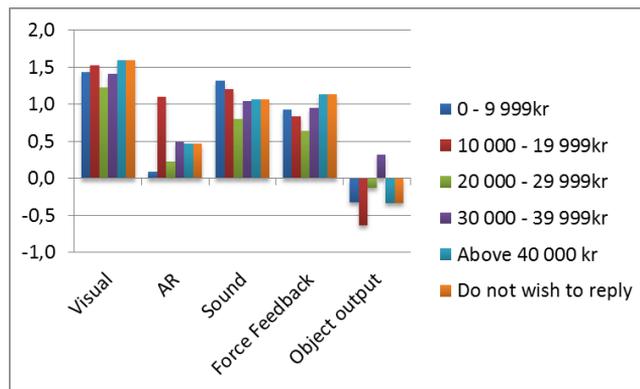


Figure 13.45: Popularity of the output elements, by income

Again, the subgroups are fairly in agreement. The 10k income group shows a spike on the AR output question, being very much more interested in the

others. On the other questions we see a “bowl” pattern, where the interest declines over the first two income groups, and improve over group 4 and 5. The exception from all this is the last question, object output. In object output, we see a growing dislike in the two first groups, a slight dislike in the third, a distinctive positive reaction from the 30k group, and a marked dislike from the 40k+ group. As usual the unknown group is equal to the 40k+ group for all questions.

13.3.5 Social elements

Social elements are increasingly important in today’s games and applications. The four elements we have asked about in this survey are: Player versus Player (PvP), the ability to compete against other players. Cooperation (Co-op), the ability to cooperate with other players towards a common goal. Chat, the ability to communicate with other players. Learning, that the game should teach the player something.

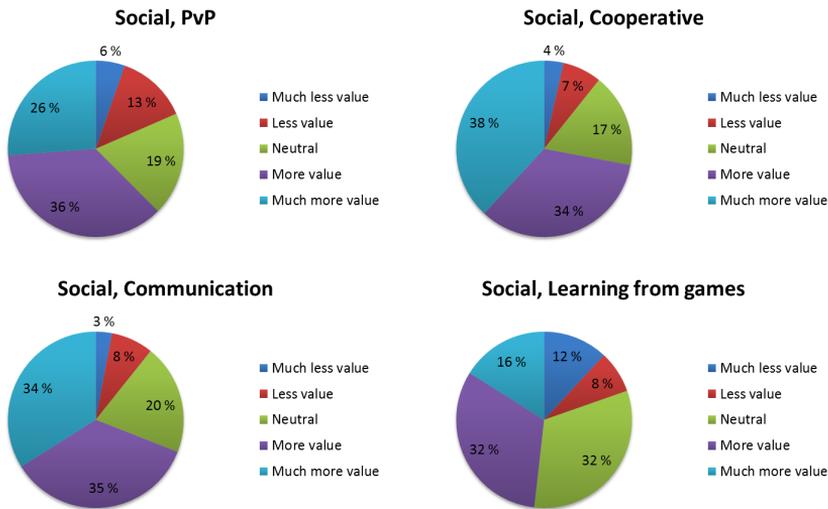


Figure 13.46: Popularity of the social elements

We can see that all the social aspects are important for players, especially the coop and chat aspects.

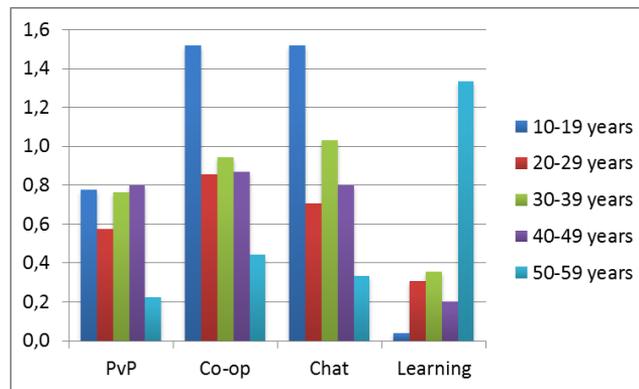


Figure 13.47: Popularity of the social elements, by age

When we look at the different age groups, we can see they are fairly the same, except for the youngest and oldest age groups. The youngest age groups are extremely more interested in the coop and chat aspects, while the oldest group are less concerned about the first three (PvP, Co-op and chat) than the other groups, but extremely much more interested in learning things from games.

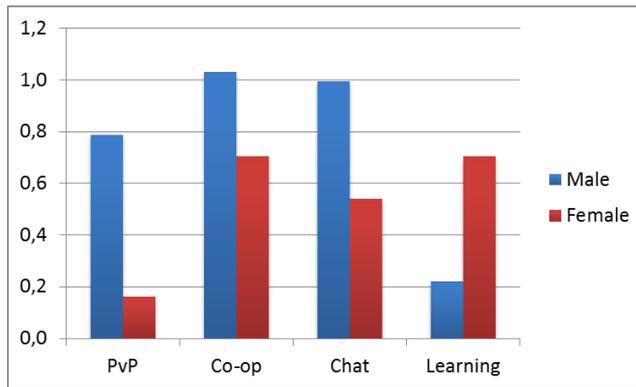


Figure 13.48: Popularity of the social elements, by gender

The genders are unusually divided on this matter. Females are much more likely to appreciate games where the player learns something from the game, and by far less likely to appreciate PvP games. The difference is smaller, but still very large for the other two questions. Females think coop and chat are less important than males do. Some of the learning focus for females may be due to the fact that most of the females who took our survey came from NTNU.

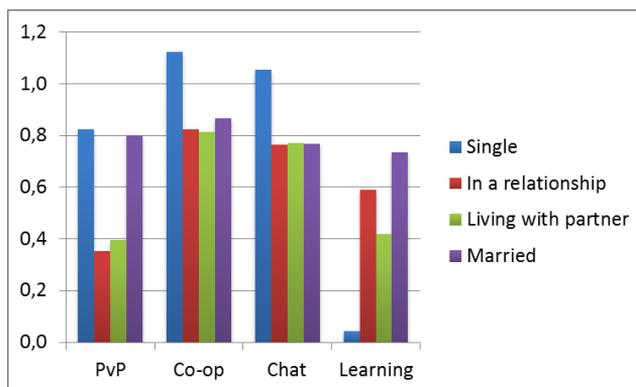


Figure 13.49: Popularity of the social elements, by social status

Single people are, along with married people, very much more lightly to enjoy PvP games than the other groups. Single people also stand out of the crowd on the Coop and chat options, where they think it is much more important than the others. the rest are just about equal in these questions. For the learning question, singles think it is a lot less important than the others do. Married people are the most interested in learning from games.

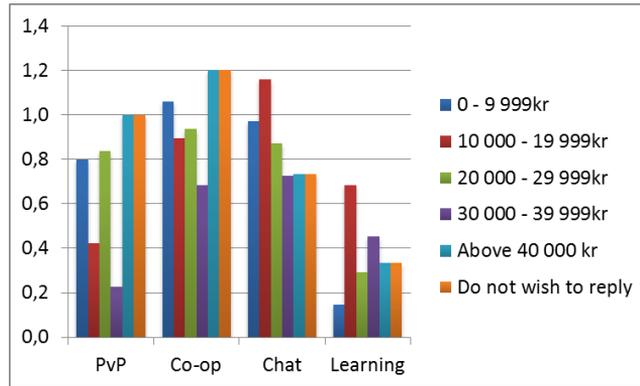


Figure 13.50: Popularity of the social elements, by income

When grouped by income, the income groups are very erratic for some of the questions. For chat and coop we seem to get a correlation between lower income and interest for the chat option, with the 10k group being more interested than the rest in chat and the 40k (and unknown) group is more interested than the rest in coop, but for the others there is too much variance.

Answers to research questions

These are the answers to our research questions. The questions and motivation are listed in chapter 2. The rest of this chapter sections have a rich answer to each question.

RQ1 What are the players usage patterns for mobile games?

- ▷ *Game session frequency: 43% of portable gamers report that they play between 1 and 3 sessions in the time period Monday - Thursday in an average week, and 15% report playing between 4 and 6 sessions. 34% play 4-15 sessions in this period.*
- ▷ *Game session length: most respondents replied that their average session length is between 0 and 15 minutes (70% on weekdays, 69% on weekends).*
- ▷ *Main activity or product of some other activity: is the player using the game only while waiting for a bus, cooking dinner, and so on: Yes, our results suggest that portable gaming often is a product of another activity, with over 50% of the game sessions on portable devices being performed alongside some other activity.*
- ▷ *Intention or motivation for playing a game: Asking users to rank six different pre-defined reasons (relax, social, competitive, time consume, addiction, entertainment), it seems that relaxation, entertainment and time consume are the most used alternatives. Already, this might suggest that gaming on portable devices often are a result of performing or waiting for some other activity. We also asked respondents to elaborate on these reasons, supplying their own in addition to our pre-defined reasons. The most common reasons mentioned in these open question replies were reasons like playing while out traveling, waiting for the bus/train, waiting at the airport and so on.*
- ▷ *Multiplayer usage and social situations: from our survey, we found that while multiplayer functionality is widely used on stationary devices like game consoles and computers, mobile devices does not see the same usage levels. Only 10% of the gamers on stationary platforms report that they never play with others. The same number for portable devices are 62%. Also, for stationary devices, 63% report to play with others more than 20% of the time, while portable devices only see 13% answers on these alternatives. It is then a fact, multiplayer functionality on portable devices are not used much*

RQ2 Does pervasive games bring games to a larger segment of the population?

RQ2.2 Does pervasive games recruit individuals that does not normally play games?

RQ2.3 What are potentially new players attitudes towards pervasive games?

When asking about how they would think the value of the pervasive elements would change the game value, over 60% were positive. The ones answering positive to these questions often commented that it depends largely on the actual implementation.

Investigating how a games value would change with pervasive elements for the non-gamer group, we found that around 48% of non-gamers think that pervasive elements could bring additional value to games. Only 11% are negative towards these elements.

We have therefore concluded that pervasive elements may be helpful in bringing games to new players. It is however very dependent on the gameplay, as pervasive elements themselves are not enough to save a game with poor gameplay.

RQ3 For pervasive games, does event driven game modes bring additional value to games?

Yes, our research suggests that peoples attitudes towards these game elements are positive.

RQ4 What pervasive elements are liked? Are there any differences in population subgroups based on gender, income, age or social status?

For pervasive games, we find that the success of pervasive elements are very dependent on the context they are in.

The most popular elements are location aware games, proximity based gameplay and augmented reality.

RQ5 What pervasive elements are not liked? Are there any differences in population subgroups based on gender, income, age or social status?

Again, for pervasive games, we find that the success of pervasive elements are very dependent on the context they are in. Voice input elements were most disliked among the elements.

14.1 RQ1 - Usage patterns

RQ1: *What are the players usage patterns for mobile games?*

We set out to investigate usage patterns for games on portable devices, and by having some 655 respondents on our patterns survey, we have got a result. When reading the results and the discussions, it is important to remember that our demography is somewhat skewed, with a weight on young males.

In section 2.2 we defined usage patterns:

- ▷ Game session frequency: how often does a player start a game session
- ▷ Game session length: for how long does a player usually use a game
- ▷ Main activity or product of some other activity: over 50% of the game sessions on portable devices are performed alongside some other activity
- ▷ Intention or motivation for playing a game: Relaxation, entertainment and time consume, most common reasons mentioned were reasons like playing while out traveling, waiting for the bus/train, waiting at the airport and similar
- ▷ Multiplayer usage and social situations: does the player use multiplayer, how often does the player play with friends - in real life? Over the Internet and similar technologies?

For game sessions on portable devices, we expected to find that mobile games had a relatively high frequency - short length style session. For session length, our findings confirm that the portable game session is very short. Most respondents replied that their average session length is between 0 and 15 minutes (70% on weekdays, 69% on weekends). Only 5% play more than 1 hour on the weekdays, and 4% on weekends. Based on these numbers, one can also see that the different in session duration are practically non-existing comparing weekdays and weekends.

Comparing session duration for portable and stationary devices, there are great differences. If we look at the numbers for weekdays, while 70% of the portable device gamers report a duration between 0 and 15 minutes, 59% of stationary platform gamers report playing sessions between one and four hours. Only 15% reports sessions on the same level as the majority of the portable gamers, between 0 and 15 minutes.

Due to the nature of the portable device, its usability, user friendliness and so on, these findings are not unexpected. The reason for the short duration might be as mentioned the device and games themselves, but by investigating the reason or motivation for playing games on portable devices, one could explain this further. These reasons will be discussed later in this section.

We also look at session length for the different income groups, genders, age groups and social situations. There are only small trends in the data considering income and age (see section 11.6.3). It might be that there are other parameters that are more important in our respondents than these. For males compared to females however, females seem to have a longer session duration than the male population. For weekends for example, around 50% of the males report having sessions between 6 and 15 minutes, while the same number for females are only around 30%. The remaining 20% females seem to have answered that they have longer session (between 16 minutes and 2 hours). The other data that stands out are married persons compared to other social situations. This group have nearly 60% responses on the 6 to 15 minutes alternative, while a bit lower response rate on the longer session duration alternatives. No particular reason or conclusion have been found that would explain this data. However, it is important to remember that we have a relatively low percentage of females and married persons answering the survey. This means that the extremes of any respondents will count for more when there are a low number of participants, possibly disturbing the results.

While our expectations were met on the session duration being short, it does not seem that the expected high frequency session style is present. Knowing what a high or low frequency means, is not that easy, so we focus on comparing to the results for stationary devices. As the session length for stationary devices are long compared to portable devices, the frequency should be relatively low.

43% of portable gamers report that they play between 1 and 3 session on the weekdays, and 15% report playing between 4 and 6 sessions. For stationary players, these numbers are 34% (1-3) and 26% (4-6). The alternatives on the other end of the scale have very much similar responses, but the “over 20” sessions alternative have 11% respondents on portable and only 4% on stationary. This data means that there are more players on portable devices playing very many sessions each day. However, in total it seems that stationary gets more session in total, with more responses on 4-15 sessions (51% versus 34%). This might actually mean that our respondents use their computer or consoles more on average than their portable devices when it comes to gaming.

Investigating the reasons for playing games on mobile devices, it seems like it is very often a result of being engaged in some other activity. Looking at the graphs from the results chapter, it is very easy to find that shorter game session durations might be due to the reasons for playing. Actually, it seems like over 50% of the game sessions on portable devices are performed alongside some other activity. For stationary devices, this number is very different, with the gaming activity being the main activity most of the time. This effect is easily seen when studying the mean and median response values for this subject. The mean and median values for portable devices suggest that 50% of the time, portable gamers play alongside some other activity. The same median and mean values for stationary gamers are centered around the alternative suggesting stationary gamers only performing another activity while gaming between 1% and 20% of the time.

So, gamers on portable are doing something else while playing. But what? Asking them to rank six different pre-defined reasons (relax, social, competitive, time consume, addiction, entertainment), it seems that relaxation, entertainment and time consume are the most used alternatives. Already, this might suggest that gaming on portable devices often are a result of performing or waiting for some other activity. We also asked respondents to elaborate on these reasons, supplying their own in addition to our pre-defined reasons. The most common reasons mentioned in these open question replies were reasons

like playing while out traveling, waiting for the bus/train, waiting at the airport and so on.

Looking at the different motivations for playing sorted by age, there are small differences. The older age groups seem to use games for relaxation the a larger extent than the younger generations. It also seems like this is valid for people with high income, they use games for for relaxing. The income groups between 10 000 NOK and 30 000 NOK also seem to be more competitive. Of course, this might also be due to other factors (like education, age, etc). Not surprisingly, males more often answer that they play games for competitive reasons than females.

The conclusion must be that players on portable devices rarely go to these devices for entertainment on their spare time, like with stationary devices like computers and game consoles. Instead, it seems that portable devices are most often used to pass time or shortening the wait while being engaged in some other main activity.

For multiplayer usage, we found in our prestudy that many games on portable platforms have multiplayer functionality included. We wanted to find out to what extent these features are being used today. We believe that pervasive game elements could help improve the multiplayer functionality in mobile games.

From our survey, we found that while multiplayer functionality is widely used on stationary devices like game consoles and computers, mobile devices does not see the same usage levels. Only 10% of the gamers on stationary platforms report that they never play with others. The same number for portable devices are 62%. Also, for stationary devices, 63% report to play with others more than 20% of the time, while portable devices only see 13% answers on these alternatives. It is then a fact, multiplayer functionality on portable devices are not used much.

So, why are multiplayer not used on portable devices? When we concluded on game frequency and duration, we found that these sessions are most often very short (below 20 minutes). Investigating motivations for playing, we saw a trend that these reasons are often due to a wish to pass time while performing some other activity (classic waiting for the bus kind of situation). Then, if all multiplayer functionality is designed to play live with others, like on computers

and consoles, it does not fit the usage patterns for portable devices. It might seem that asynchronous multiplayer features might fit the usage patterns in a better way than traditional game modes.

Another reason why gamers are not using multiplayer features might be that current implementations from our experience is not very easy and practical to use. For many games, a user have to host a session using the local WLAN and similar style hosting. Then the other players have to join in, being around the same network. This is very much similar to the early multiplayer features of stationary games. It could be that multiplayer features would be more widely used if the ease of use is improved by moving towards the current status of multiplayer functionality in computers and consoles, where a centralized server connect players and do the job of connecting players.

Looking at the income parameters for multiplayer, there are no great differences. Some minor are there, but not enough to see any clear trends. For age, it seems that the all the age groups except the youngest (10-19 years) have a never use answer ratio of about 60-70%. It is interesting to see that the youngest group only have 40% never use answers, meaning that they use multiplayer functionality a lot more than their older co-gamers. By gender, another trend is also present in the data. While 66% males never play with others, 41% of the female population answer the same, meaning that females use multiplayer functionality on portable devices more than males. In order to find a reason for this, it might be necessary to investigate what games are popular among females compared to males. For social status, there are only minor differences. The married group seems to play less with others, however, there are not enough responses in this group to draw any conclusions.

14.2 RQ2 - Larger segment of the population

***RQ2** Does pervasive games bring games to a larger segment of the population?*

***RQ2.2** Does pervasive games recruit individuals that does not normally play games?*

***RQ2.3** What are potentially new players attitudes towards pervasive games?*

Users were asked about pervasive elements in both surveys.

From survey I we found the general attitude towards pervasive elements to be positive. 12,5% had even tried a game in which they by our definition considered location based, and over 20% answered that they had tried a game mixing elements from the real- and virtual world. Most of them reporting trying games with synched time and weather between the real and game world.

When asking about how they would think the value of the pervasive elements would change the game value, over 60% were positive. Very few answers were on the negative side of the scale, however, it is important to understand that this was a general question about a game element. Many might have difficulties imagining what this actually means for their game experience. The ones answering positive to these questions also often commented that it depends largely on the actual implementation - and that it is difficult to answer based on a generic question.

The ones with a negative reply on value change for pervasive elements often mentioned their main reason for gaming as a reason for not believing in pervasive elements. The most common reason were respondents saying that they are playing as an escape from the real world, and they not want realism and real world elements in their escape world (game world).

Based on the questions from survey I, it seems like most people are positive to pervasive elements, and that they find them exciting. However, there were a very few very limited questions. The definitions and explanations were also limited. They might not have completely understood all the different elements

of pervasive games. Even so, the elements that they did seem to understand were mostly enjoyed.

We also wanted to see if pervasive elements could do something to non-gamers attitudes towards games in general. If pervasive elements brings any new value recruiting more players. Investigating how a games value would change with pervasive elements for the non-gamer group, we wound that around 48% of non-gamers think that pervasive elements could bring additional value to games. Only 11% are negative towards these elements. Without any knowledge on why they do not play games, it is interesting to see that around half of the non-gamers are positive towards pervasive elements.

14.3 RQ3, RQ4 & RQ5 - Pervasive elements

RQ3 For pervasive games, does event driven game modes bring additional value to games?

RQ4 What pervasive elements are liked? Are there any differences in population subgroups based on gender, income, age or social status?

RQ5 What pervasive elements are not liked? Are there any differences in population subgroups based on gender, income, age or social status?

In the second survey, we approached pervasive game elements from two angles. Firstly, we proposed three concepts to the participants of the survey, and asked them what value the concepts represented in relation to a base concept we used as a reference. The participants were also asked in what styles of play they would most enjoy the concepts. Whereas, in the second approach, we used a framework proposed by Hong Guo[22]to identify some pervasive elements, and asked the participants what the value of the element would be to them.

RQ3 is answered in the next section (13.3.1), with the answers and results for RQ4 and RQ5 are present in all the following sections.

14.3.1 The concepts

The base concept got a fairly neutral score, with 35% of the participants saying they were neutral, 35% being positive or very positive, and 30% being negative or very negative. When we look at the different play styles, we see that all of them got about the same level of negative responses. The event styles generally have better responses than the non-event game styles, while team styles are more popular than solo playing styles. When we look at the other concepts, we will see a continuity of this trend.

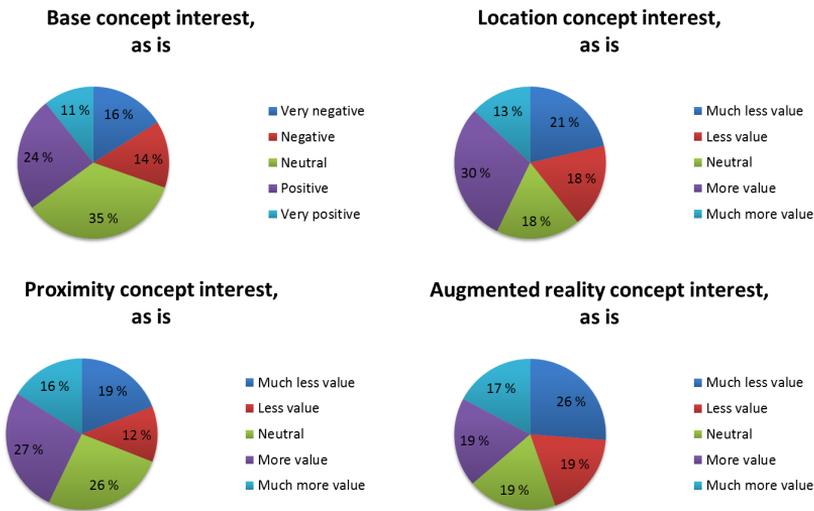


Figure 14.1: The interest of the different concepts without regards to game style

When comparing the concepts, the most popular concepts are the proximity and location concepts, with respectively 33% and 43% of the population being positive or very positive to the concepts. At the same time, the proximity and base concepts are the ones with the least negative responses. The location based and augmented reality concepts are the concepts on which the participants are most divided, with less people being neutral.

Males and females have different perspectives on the pervasive elements. Females seem to be generally much more well disposed to the concepts, except for the augmented reality concept. The largest largest differences between the genders in are seen in the base concept, where females are mainly positive while males are mainly negative. This could be due to the nature of the game, and what the people in the subgroups normally play. This is negated by the way we ask the questions in the other games, however (by always comparing them to the base concept). In the other concepts we do not see the same amount of dissimilarity between the genders. Still, there are differences. Females seem to enjoy the location concept when played as a Team PvP event very much more than males do. They also more positive to the proximity concept “as is”. When it comes to the Augmented Reality concept, females are much more negative than males to all the different styles of play. Again, some of this could be due to the female group being smaller (in the second survey, we only had 37 females, versus 131 males).

By income, the different groups are much the same. There are some trends as to the lower income groups being generally more positive, though this trend does have some discontinuities. For some of the concepts, we can see a slight curvature in some of the play styles when plotted over income. Because of the large degree of discontinuities, it is difficult to identify other large trends. One reason for the lowest age group to generally be the one which is most positive (and often very different from the rest of the groups), could be due to the large amount of students (who mostly belong to this income group). Roughly 45% of the participants of survey 2 were students. Students are often younger than the average public, and may skew this income group.

The different age groups are also very divided, even more so than the income groups. When we look at the base concept interest, for example, we can see that the first and third age groups are similar (except for the Team PvP event option), and the second and fifth age groups are similar. The main trend we can bring out of this data is that the youngest age group are the most lightly to be interested in pervasive elements. At the same time, we do see some spikes from the 50-59 year group, but we cannot explain this. It is noteworthy that the youngest age group is the only age group to be positive to the augmented reality concept.

14.3.2 The pervasive elements

Five classes of elements describing pervasiveness of a game were identified from a pervasive elements framework suggested by Guo et al.[22]: Temporality, Mobility, Input, Output and Social.

Temporality

From the temporal elements, we see a clear increase in value favoring sessions who are not limited to a given time frame, which can be started and stopped at any time without penalty. People still enjoy the classic limited time session style of play (having a 42% positive or better, and 29% negative or worse rating), but not as much as the non-limited sessions (with 92% positive or better, where 59% is very positive, and only 4% negative or worse rating). Asynchronous gameplay is rated very neutrally, but slightly negative (with 33% positive of better, and 46% negative ratings).

In the breakdown by age, we can see there is a trend for people to be more positive by age to the limited time element, with the second and fifth age groups breaking from the linearity, giving the graph a curve, with valleys in the 20s and 50s. In the freedom of time element, we see peaks in the 20s and 50s, and valleys at 10-19 and in the 40s.

Gender wise, males seem to be slightly more interested in all the temporal elements than females, especially the limited time and asynchronous elements.

The breakdown by income is very flat, where people of lesser income are less interested in the limited time element, while all groups are roughly equally interested in the freedom of time concept, and all but the 40k+ and do not wish to reply group are negative to the asynchronous gameplay. There is a great discontinuity in the asynchronous element, where the interest seems to lessen with greater income, up until the 40k+ group, which is very positive.

Generally, for the temporal elements, we can see that the freedom of time element is the most popular over all demographics, while the limited time concept is favored by older people with more money. The only people who are positive to asynchronous gameplay are married people with good income. It

should be noted, however that asynchronous gameplay is much more suited to a mobile multiplayer experience than other types of multiplayer. Asynchronous gameplay may therefore be required if one is to make more and better mp games for mobile devices.

Mobility

The mobility elements we identified were the ability to play everywhere (closely linked to the anytime of the temporality element) and the location aware type of game, where the location of the user is used as a part of the game. Overall, people are pretty neutral to the anywhere element, with op pinions being 42% positive or better, and 40% negative or worse. For the location aware concept however, only 32% felt it would improve a game, while 48% thought it would reduce the value of a game. It would seem that people are reluctant to being forced to move somewhere in special to play a game.

By age, we see a correlation between age and a positive attitude to being able to play anywhere. When it comes to the location aware concept, we see the first age group is the only one positive to the concept, while the 20-29 and 30-39 groups are especially negative.

When we look at the genders, we can see that females are slightly more interested in the play anywhere concept, and much much less interested in the location aware concept.

Income wise, we see a strong correlation between interest for the limited time concept and income.

Generally, for the mobility elements, we can see that the limited time element is favored by older people with higher incomes, while location aware games are only popular in the 10-19 years age group.

Input elements

In this section, we proposed five styles of input: Visual, Voice, Bio, Location and Object interaction.

Most styles of input are generally equally liked and disliked (having 41% - 51% positive or better, and 25% - 38% negative or worse ratings), most being slightly favored, except the voice input method. The voice input method has a large 33% who strongly dislike it, and a whole 52% who either dislike or strongly dislike it. Some of this is probably due to this method being the only widely used “experimental” method. While there are some visual input methods around, there are far more voice input systems today. Both methods work with fairly low accuracy, but the visual systems of today are mostly used for fairly simple gesture recognition, while current voice recognition systems try to recognize and understand common speech. Most voice recognition systems of today work pretty badly, due to the great complexity of human language. The low score of voice input may therefore be due to the previous bad experiences of the users.

From the age composition, we see a tendency for younger people (over the age of 20) to dislike the voice input the most. This could be because this age group would be the one most exposed to bad voice implementations earlier, while the 10-19 year group has not been equally exposed, as well as the 50-59 age group.

By gender, males seem to be generally more positive to all the input elements.

Income wise we do not see much linear trends, except in location input. In the first four income groups for the location input method we see a correlation for higher income groups being more positive to it. This trend stops for the 40k+ group, however, who is more negative than all the groups except the lowest income group.

Output elements

We proposed five output methods: Visual, AR, Sound, Force Feedback and Object feedback. It should be noted that most games made today have visual and sound output, and is considered to be necessities for modern games.

The traditional elements have scored pretty high in the survey, with only 3% meaning visual output lessened the value of games, and 7% meaning sound output lessened the value of games. Visual output is pretty much needed, while sound output is preferred. Augmented reality output scores pretty high

considering our previous results where AR scored very low. It may be that the participants rejected AR in the setting of the game, rather than the concept of AR itself. From the data, we see that only 23% have negative or worse attitudes towards AR, while 46% have positive or better attitudes towards AR. Force feedback is even more popular, with only 9% being negative or worse and 68% being positive or better. Many modern consoles have force feedback systems in the controllers, so it seems that most of our participants have had good experiences with this technology in the past. The object interaction output method, however is perceived slightly negative. 46% of users are negative to the concept, while only 32% are positive. Privacy concerns may be some of the cause of the output input/output methods scoring this low, as well as a lack of a clear area of utilization (it may be that this method of output would score better if we had proposed some interesting concepts using it).

By age groups, visual methods are very much agreed upon, but we see a correlation between a positive view of sound output and younger age groups. It may be that older users find sound effects distracting, but the change between the youngest age group and oldest age group is not that great (about 0.4 in a space of [-2,2]). Force feedback output is favored greatly by the youngest age group, but after that we see a great fall in the 20-29 age group with a further correlation where older people are more positive. The fall is hard to explain, it may be that the people in the second and third age groups have had bad experiences with older force feedback systems, or that people tire of force feedback over time. With object output we see that the most positive are the oldest age group, with the rest of the groups forming a curve with a valley at 30-39 years. It seems like there is no great correlation between age and attitudes towards AR.

Gender wise, we do not see much difference, generally males are slightly more positive to the output methods. With object output we see that males are distinctly less negative towards the concept.

When we look at the income groups, there is no great correlations with the visual method. The AR method has a slight correlation between higher income and more positivity, with the second income group standing out with a very positive attitude towards AR. Both sound and force feedback may be seen as curves with valleys in the third income group. For the sound feedback method, we see the youngest age group is most positive, while for the force feedback method we see the above 40k and do not wish to reply groups are most prominent. Object output peak at 30k, and has valleys at 10k and 40+.

Overall, the traditional elements are stapled, and very important for any game. The force feedback element is very popular throughout the demographics, while only some people would enjoy object output. Further, it would seem that AR is a popular output element, but is very contextual. It, like many other game elements, must bring some additional value to the game other than just being AR to be useful.

Social elements

We looked at four social elements: Competitive play (Player versus Player / PvP), Cooperative play (Co-op), Communication with other players and Learning from games.

Firstly, all of the social elements are very positively received. PvP has 62% positive or better responses, Coop has 72%, in-game communication has 69% and learning from games has 48%. It would seem that most people find these elements very welcome. Only 19% perceive PvP as negative, 11% perceive coop and communication as negative and 20% perceive learning as negative. The greater part of negative responses for learning compared to the others, may be due to players thinking of learning games as dull because there often is a trade off between gameplay and learning.

Age wise, we see that most people enjoy PvP, with the oldest age group being distinctly less positive than the others. This distinction from the other age groups is also seen in the coop and chat, while for the learning element, the oldest age group is very much higher. It would seem that people in this age group (50-59 years) greatly emphasize the learning aspect of games over the other social aspects. For both Coop and chat we see a great difference in how the youngest age group perceive the aspects compared to the others. The youngest age group is very much more positive to these elements than the others. The rest of the age groups are fairly similar, with the third group being slightly more interested than the second and fourth.

By gender, we can see that males greatly enjoy PvP, Co-op and chat more than females, while females enjoy the learning aspect much more than males. The difference between the genders for PvP is to be expected, as males tend to be more competitive than females, but the difference in Co-op and chat is not as

easily explained. For the learning aspect, this may be due to our student bias. Most of the females who participated in our study were students, who may therefore be more inclined to enjoy the learning aspect of games.

When it comes to income, we see huge differences between the groups in PvP, while the coop aspect shows a slight curve where the first and fifth groups are peaks, and there is a valley in the fourth group. For chat, we see a general tendency for lower income groups to enjoy the chat aspect more than higher income groups. For the learning aspect, we see a slight correlation between higher income and interest for learning.

Elements summary

When we look at the elements, we can see what elements are the most popular and therefore most suited to being included in pervasive games. For temporality, most people enjoy to be able to play when they want to, and being able to start and stop the game at will. There is some skepticism (people are pretty neutral) towards asynchronous gameplay, but if one is to include multiplayer one probably should use this method. The main reason for this is that we want to keep the session non-limited to time constraints. If two players must play at the same time against each other or cooperatively, both must be connected, which implies time constraints. With asynchronous gameplay there is no need for both to be connected at the same time to interact. Some of the skepticism towards asynchronous gameplay may be due to the players not wanting to be disturbed with notifications when they are doing non-game related activities. At the same time, using such notifications prompts the player to play more. There is therefore a trade off between notifying the player too often (making the player tired of the game) and notifying the player too rarely (not giving the player any idea of what is happening in game, risking losing the player due to inactivity).

People are slightly positive to mobility, so being able to play it anywhere is preferred. Location aware elements are looked at slightly negatively, and should only be included if it is paramount for gameplay. It may be that location aware games would be able to get a user group, but it is not at the moment suited to mass marketing.

When it comes to input methods, people are very sceptical to voice input. Voice input should therefore only be used if implemented properly (being able to fully understand normal speech), and would not necessarily be positive advertisement (due to the negative opinions toward voice input). It seems like voice input is not at the moment ready for mass usage. Visual input and location input are the most promising methods in peoples opinion. However, they should only be used if they add something to gameplay, and not used as mere gimmicks. Bio input and object interaction might also be used in the right circumstances.

For output methods, visual and sound outputs are staples of game development. Force feedback is popular, and may be used freely. Augmented reality is popular, but as we have seen, very contextual. AR should only be used if it improves gameplay. For object interaction, people are neutral/slightly negative, and therefore should only be used if strictly necessary.

The social elements are all popular. A combination of PvP and Co-op gameplay with communication is a sure winner. In addition, people will perceive to get more value from the game if they feel they learn something from it. It should, however, not be traded for gameplay.

Part V

Evaluation

Discussion

As noted in the *Research questions* chapter (2.3), we undertook this project to better understand the people who play or might be interested in playing pervasive games. The intention was to help developers make better and more suited games to these people, and in that process provide a tool which might make it easier for pervasive games to succeed.

This document should be able to provide help to developers for mobile devices. We have provided data on the subject, and answered our research questions. That being said, this project is only the start when it comes to properly understanding people and their relationship to pervasive games. As noted in further work (chapter 17), there is a lot one can do in this field: correcting bias, making more detailed in depth surveys or creating pervasive games prototypes using this document as a framework.

15.1 Pervasive elements

From our work with RQ4 and RQ5 we have come up with a description of what characteristics would be positive for games on mobile devices.

Players want to be able to start and stop their game sessions at any time, and play for any length of time. This is different from stationary devices, where most games are more time consuming and people often have to get to a save point, or finish the session (for multiplayer games) to avoid losing their score or data. This point is also backed up from the usage patterns from RQ1.

Social elements are very popular. Players want to be able to compete against other players, especially in teams. They also want to cooperate with others to reach goals. Some method of communication is essential if this is to be possible, and also has value in itself. In RQ1 we saw that currently, not many play multiplayer games on mobile devices. This is probably because of the currently available games. In our market investigation (Chapter 5) we saw that multiplayer functionality is popular with game developers (often created), but not the standard (less than 20% of the games on the market has MP functionality). If multiplayer is to be implemented, it should be asynchronous, as people have to be able to play whether or not their friends are online. This to comply with the “play at any time” characteristic.

If the player feels he can learn something from the game which is useful outside the game, it brings further value to a game. However, this should not impede gameplay or in any way be a trade off against the entertainment value of a game.

According to RQ4 and RQ5, people are interested in new methods for input, like visual, location (GPS) and object interaction input. However, people are very sensitive to badly implemented input methods. It is therefore a risk to develop a new input system for a single game if the developer do not have the necessary skill and funding to make a complete and intuitive well polished input system. People are very sceptical to the use of voice input, probably because of bad implementations in the past.

As for output methods, RQ4 and RQ5 shows that classic methods like visual and sound feedback are necessary staples of video game development. Force

feedback is popular and well proven. People are, however concerned about object interaction output, probably due to privacy issues. When it comes to AR, it scored low in the concept part of the study, but when asked about AR as an output system, the participants were positive. We therefore concluded that AR, as well as other pervasive elements, should be used only when it brings additional value to the gameplay.

It may be destructive for the game itself and for pervasive games generally to use pervasive elements as gimmick's if they only get in the way of gameplay. The same is true the other way, with good combination producing better results than the element in itself. People were very sceptical when asked about location aware games as a game element, but positive to the location aware game concept. This may be partly due to our wording in the survey, but is probably also due to the context. In the game concept, the location aware aspect of the game changed the game for the better.

From RQ3, we can see that event driven game modes do bring more interest than non event driven game modes. The question is whether the added value surpasses the additional work of scheduling event type play. It is harder to gather people to play at a given place and time than it is to just use asynchronous multiplayer. This question could be addressed in a later survey. Nevertheless, it is clear from RQ3 that people are interested in this event style play. This type of play could probably be suited to marketing campaigns and sponsored events, as suggested in the report about The Drop[31].

In the end, RQ2 shows us something enlightening. Many non-players are positive towards pervasive elements in games. This alone does not entail that non-gamers will be flocking to the digital markets to buy pervasive games, but it shows that these elements may be a part of the recipe we need to make the game for them. This could also be an area for further study. It would be interesting to test some pervasive games concepts on people who are not normally gamers, and see if these are greeted more warmly than non-pervasive games.

For pervasive games, we find that the success of pervasive elements are very dependent on the context they are in. As noted earlier, pervasive elements should only be used in ways in which they add value to the gameplay. Generally, developers should be very careful to avoid using any new technology in any way which may get in the way for players enjoying the game. Of the pervasive concepts we tested, the proximity and location elements were the most popular,

while the AR element received a poor score. The second part of survey one showed a positive public opinion towards AR, so our use of AR must have been at fault. It may be that other applications of AR would have more success.

- ▷ **Location aware games:** Users are neutral to this type of element in itself, but when used to further gameplay it was popular. Preferably the users location should be used to enhance the content or provide better content based on the nearby area.
- ▷ **Proximity based gameplay:** Social elements are very popular, and proximity based gameplay is generally liked. Gameplay relying on interaction with nearby players may be rewarding, but is risky as the game requires a critical mass.
- ▷ **Augmented Reality:** AR is generally liked, and people view it as a promising new technology. That being said, people will respond badly to implementations of AR if it is used only as a gimmick. If AR is to be used, it should be an integral and important part of the gameplay, and the developer should be careful to make sure AR is not seen as an obstacle, but a game element.

15.2 Game design recommendations

RQ1 showed us that on mobile devices, players generally have much shorter sessions than on stationary devices. Most players reported a total session duration between 0 and 15 minutes (70%). This should be taken into account when making mobile games (unless in some way trying to change usage patterns). A game created in a manner forcing the user to play 30 minute long sessions before achieving a result might not be a success due to this fact.

From RQ1 we also see that people often play to pass the time while they are doing other things or waiting for something. Actually, it turns out over 50% of the game sessions on portable devices are performed alongside another activity (often waiting for transport and similar activities). Because of this, it is paramount that the game is quick to start and can be ended with short notice, so that the user does not use the waiting time waiting for the game to start.

For usage patterns, most of our results were not too surprising. However, for session frequency we expected to find that the number of sessions were higher. We thought we would find a short duration - high number of sessions kind of gameplay. Our actual results shows us that this is not the case for the number of sessions played. This might be due to our survey participants playing more on their stationary devices than their portable ones.

To summarize, our results, discussion and project leads us to the following recommendations for games on portable devices:

- ▷ **Play at any time and for any duration:** Users would like to see a session length that fit their playing style. There should not be a limit on how long a player have to play in order to gain something from the session. For example, the user should not be tied to a session for a fixed period of time, he or she should be able to quit playing after a very short while and still gain something.
- ▷ **Asynchronous multiplayer:** Multiplayer is important to players, but our results show that not many use these features as of today. These features need to fit the session style we have found, especially the first point of this list. Asynchronous multiplayer is our recommendation, as this enables the user to play at any time and for any duration.
- ▷ **Learning in games:** This is also a important for players, however, it should not impede gameplay or in any way be a trade off against the entertainment value.
- ▷ **Short sessions:** If a game is created to fit current gameplay sessions it should support short duration sessions, between 0 and 15 minutes sessions.
- ▷ **Quick start, quick end:** As a result of short sessions, users must not be bothered using time on start-ups, game saving and quitting. Therefore, games (and game sessions) should be very fast both to start up and end.

15.3 Threats to validity

15.3.1 Construct validity

To ensure construct validity for our two surveys, we did a lot of prestudy in the field of performing surveys. Based on this prestudy, we found several different factors important for validity creating surveys. Part III of this document explains the measures taken to ensure survey quality.

One of the most important measure were pre-tests. For survey I, we developed a pretest version of the survey, with open-ended questions. Although we planned to do a close-ended questions survey, we did the pretest open-ended in order to see that all respondents firmly understood the meaning of the questions. 25 people participated in pre-test 1. This test lead to a series of changes and these were also tested in a second test. The results from both tests can be read in section 9.3.

Survey II might actually contain some threats to construct validity, due to the fact that we did not have the time and resources to test this survey as extensively as survey I.

Most of the problems with the two surveys are identified in the respondents feedback section, read it in section 16.3 and 16.4.

15.3.2 Internal validity

Discussing survey methodology, there are some design choices that may introduce threats to internal validity on results. First, we have asked users to remember a lot of information on usage patterns. Although we have utilized some measures in order to make this process as easy as possible for the user, we can not say to which extent these results are different from the actual facts. We have to rely on the respondents memory. Further on, for pervasive elements, we have asked the user about his or hers opinion to theoretical concepts. We do think that most of these results are good. As for usage patterns, we can not say if all users have understood all concepts or if their opinion towards a

theoretical concept would be valid for an actual game implementation. This could also be a subject for further work.

Prices were used to ensure enough respondents for both surveys. This might be a threat to internal validity as some users might have answered the survey randomly in order to complete it as quick as possible. Considering the amount of respondents in the surveys and our use of median values instead of mean values, a low number of incorrect responses should not affect the total results. However, this is difficult to measure.

15.3.3 External validity

In the results section we have presented our demography. The major age group in our survey were people in their twenties, with people in the thirties and teens coming second and third. The survey is extremely male dominated. This means that our results are most valid for this user group. We have chosen not to normalize data based on this bias in demography. The main reason for this is that we do not think what we have enough answers in all groups to make it a good way of compensating. The answers of very few would be added too much weight. Instead, we have chosen to present the facts, the actual user groups and their replies.

Our sources for respondents are two Internet game forums, one iPhone blog and facebook fan page, one e-mail list from a iPod app developer company and a student portal at a university. Based on the sources, we have reason to believe that many of our respondents are above average interested in both games and portable technology.

All these possible sources of bias are important to remember when reading the results. It seems that parameters like age, income, social status and gender sometimes lose their importance or influence due to other parameters introduced by this bias. For example, even though we have some respondents that are over 40 years old, it might be that all the respondents are extremely interested in games. This interest in games are more likely to be influencing the respondents answers, rather than his or hers age. Another factor is that the older age groups have very few responses. This will introduce bias as extreme opinions will have more impact on the results if there are few respondents.

Problems

All projects face problems, so did we. This chapter tries to explain the most important problems we faced during the project period, and how we solved or worked around the problems.

The most important problems we encountered during this project were related to finding a suitable research method, and as our choice was a method that we had very little pre-existing knowledge about, actually performing the activities and using the research method.

16.1 Choosing research method

One of the first problems we encountered in this project was the research method selection. Initially, we planned on making a game prototype, and then distributing this prototype, measuring and asking users about their experience. However, we wanted to get a more general result, for several different pervasive elements. In order to do that with a game prototype, it might be needed to create several different prototypes. Of course, as in any project, time is of the essence. Therefore, we decided to drop the prototype base research method. In addition to time constraints, we also felt that the risk with making prototypes for field testing were to severe. What if we could not distribute the game to enough users? What if we could not make the game interesting enough - making the research results biased? We decided to go with a survey/questionnaire based research method instead.

16.2 Survey methodology

With our background as computer engineers, we did not have any previous experience with creating, distributing and analyzing surveys. The first problem we faced using this approach was distributing the survey to a appropriate population. We wanted to reach all age groups, gamers and non-gamers the same. With our resources however, the problem was reaching these people. The end result was that we gave up on the dream of a perfect demographic sample, and focused on the people we were actually capable of reaching with the surveys.

The result is of course a somewhat biased population, as mentioned in the results section.

The actual survey process did not have as many problems as we predicted on beforehand. This mainly due to us doing a lot of research into survey methodology.

We predicted that the second survey would a much longer one, but it was not. Now, after the results are in, we see that the second survey actually could be

an optional part of the first survey, and that this approach probably would give us more responses.

Analyzing the results also gave us some problems. Most of our pre-study were targeted at survey creation and distributing, not so much analysis. Therefore, we did not have any knowledge on how to handle these large amount of data. Our survey website provider did have some tools, but due to some technical limitations these tools were impossible to use. The largest issue analyzing data was how to connect questions in a easy manner. For example how to see the male/female distribution on who many people play games on portable devices. We actually did not find any tools are methods suitable at the time, and ended up exporting all survey data to excel, and manually connecting results using data sheets.

Before deploying the first survey, it was thoroughly tested. For survey number two, we were not able to test the survey just as much, and we can see from the survey evaluation and results that more testing would give us a better result from this survey.

16.3 Survey I user feedback

We added a question to the survey concerning the survey itself. Respondents were asked if they had any comments on they survey. Most of the comments were positive, many even mentioning a desire to see the final results. Out of the 655 respondents, 120 chose to leave a comment.

Some complained about the percentage options given, that it was a bit difficult to answer, and that it could have been separated in smaller parts. Some users also missed a “more rarely” option, along with a “I do not know” option. This was especially for users which mentioned having a lower game frequency than the options allowed for. The most common negative feedback was users not entirely fitting into the alternatives for each questions. For example, some respondents mentioned that their response for the “game frequency” questions might be somewhat inaccurate, as there are great variations from week to week and period to period.

Considering the length of the survey, no one mentioned it being too long, which was one of the focus areas creating the survey. Actually, several users mention

the survey being about the perfect length. The median completion time for the survey was 5 minutes and 28 seconds, with a max of 15 minutes and 47 seconds. This is were we wanted to be.

On the technical side, everyone seemed to like the web pages and work flow in the survey. A couple of users mentioned a lack of “back” button, leaving the respondents unable to go back to the previous page when answering the survey.

16.4 Survey II user feedback

Survey II also included a question for evaluation on the survey process. About one third of the respondents also commented on this evaluation question, which obviously was not required.

Some respondents complained that the survey was too long, and had too much text to read. Others also mentioned that it was difficult to understand all the concepts on the survey, and that it had too high requirements for imagining how things would be, therefore resulting in some questions that were difficult to answer.

Given the general nature of the questions, some users felt it difficult to answer, and it might also be that some of the individual respondents understanding of a question was not consistent.

Overall, around two thirds of the survey feedback comments were positive.

Further work

There are several different paths to take using this project as a basis for further work. The next sections contains the suggested work using this project as a base.

17.1 Correcting bias

First, some of the problems we encountered could be eliminated for a similar project. The largest problem for our research is the bias introduced in the surveys. The problems we had were mostly related to age and bias of the survey respondents. For example, some of our results for the different age groups and genders are a bit uncertain due to the fact that there are a low number of respondents in some of these categories. This also goes for male and female distribution, as most of our respondents are male.

We did not have the opportunity to distribute the survey to a wide enough selection of the population to draw a general conclusion. This survey-style project could be done again in a similar way, eliminating the source of bias and getting a result that is valid also for the general population.

17.2 Develop games for field trials

For the usage patterns, one could imagine a project using the same patterns framework, developing actual prototypes for field testing. From a technical point of view, one could add some logging and feedback features, allowing users to explain and the games to automatically record the usage patterns. It would be interesting to see if the results from such a field trial would be the same as from asking the users in a survey.

Making the game, one should use the most popular pervasive elements from our research, combined with the usage patterns results. In that way, the game would be tailor made to the gamers current use of portable platform games. Practically, what it means is creating games with pervasive elements identified as likable and which are tailored for a short session style gaming (game sessions between 0 and 20 minutes). We also had some interesting results for multi-player support, asynchronous gameplay seem to be perhaps the most promising multiplayer game mode (based on usage patterns). This could be tested in a field trial as well.

Another interesting question to try to elaborate on with this approach is RQ2. As mentioned in the *Discussion* chapter (chapter 14), it could be of interest to see if pervasive game concepts score better when tested by non-gamers.

17.3 Elaborate pervasive elements research

We developed some minimal game concepts in the second survey, trying to find users attitudes towards different pervasive game elements. This could be done in a similar way, only with more focus on the actual game concepts. Using the knowledge about the elements in this report, one could make concepts that are more complete and perform the same study on these.

Another field which could be elaborated more is the event style of play. We have shown that it gives added value to a game, but we have not looked at how willing people are to schedule game events. In addition, further study on RQ2 could be valuable.

Conclusion

The main motivation of this project was to help developers create a better game experience with the use of pervasive elements and mobile technology, finding some pointers as to what players are likely to enjoy (or not). At the same time, the usage patterns will help understand how players currently use games, which is important information creating games tailored to the players usage patterns. This might in turn increase the chance of creating a popular game.

The research method is survey-based. We deployed two surveys, with two different purposes, giving us all the information presented in the results of this report. The first surveys main purpose is extracting usage pattern information, while survey number two goes more into depth on pervasive elements. A total number of 655 respondents answered our first survey, 168 answered the second.

As discussed in the discussions chapter, results and recommendations can be summed up as the following:

Our discussion, results and project leads us to the following recommendations for games on portable devices based on our usage patterns research:

- ▷ **Play at any time and for any duration:** Users would like to see a session length that fit their playing style. There should not be a limit on how long a player have to play in order to gain something from the session. For example, the user should not be tied to a session for a fixed period of time, he or she should be able to quit playing after a very short while and still gain something.
- ▷ **Asynchronous multiplayer:** Multiplayer is important to players, but our results show that not many use these features as of today. These features need to fit the session style we have found, especially the first point of this list. Asynchronous multiplayer is our recommendation, as this enables the user to play at any time and for any duration.
- ▷ **Learning in games:** This is also a important for players, however, it should not impede gameplay or in any way be a trade off against the entertainment value.
- ▷ **Short sessions:** If a game is created to fit current gameplay sessions it should support short duration sessions, between 0 and 15 minutes sessions.
- ▷ **Quick start, quick end:** As a result of short sessions, users must not be bothered using time on start-ups, game saving and quitting. Therefore, games (and game sessions) should be very fast both to start up and end.

For pervasive games, we find that the success of pervasive elements are very dependent on the context they are in. As noted earlier, pervasive elements should only be used in ways in which they add value to the gameplay. Generally, developers should be very careful to avoid using any new technology in any way which may get in the way for players enjoying the game. Of the pervasive concepts we tested, the proximity and location elements were the most popular, while the AR element received a poor score. The second part of survey one showed a positive public opinion towards AR, so our use of AR must have been at fault. It may be that other applications of AR would have more success.

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- ▷ **Location aware games:** Users are neutral to this type of element in itself, but when used to further gameplay it was popular. Preferably the users location should be used to enhance the content or provide better content based on the nearby area.
 - ▷ **Proximity based gameplay:** Social elements are very popular, and proximity based gameplay is generally liked. Gameplay relying on interaction with nearby players may be rewarding, but is risky as the game requires a critical mass.
 - ▷ **Augmented Reality:** AR is generally liked, and people view it as a promising new technology. That being said, people will respond badly to implementations of AR if it is used only as a gimmick. If AR is to be used, it should be an integral and important part of the gameplay, and the developer should be careful to make sure AR is not seen as an obstacle, but a game element.

Part VI

Appendices

APPENDIX



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This chapter contains the bibliography for this project report.

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